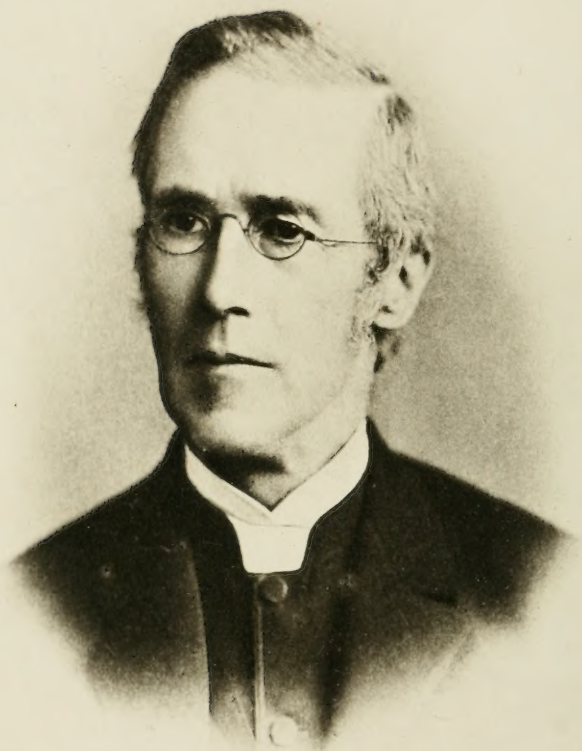


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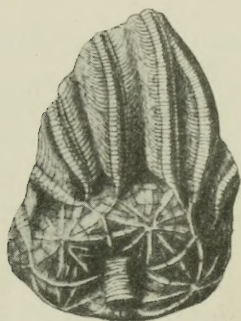
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PROCEEDINGS

OF THE

DAVENPORT ACADEMY OF SCIENCES



VOLUME IX.-10

1901-1903

Davenport, Iowa:
Published from the Income of the
Putnam Memorial Fund
1904

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PREFACE

The Davenport Academy of Sciences takes pleasure in presenting to the scientific world Volume IX. of its Proceedings.

On account of unavoidable delays three years have elapsed since the appearance of the last volume. Our publication fund is now sufficient to enable us to publish oftener, and it is hoped to send out each paper as soon as published.

The Academy exchanges publications with other institutions. Current volumes are supplied free of charge to members, on application.

The late Rev. Dr. Willis H. Barris, who was closely connected with the work of the Academy from its organization in 1867, is honored in this volume by a biographical sketch written by his son-in-law, Mr. Edward S. Hammatt. Dr. Barris's portrait forms the frontispiece to this volume, and the crinoid, *Dolatocrinus triadactylus* Barris, is represented in the stamp on the title page.

The synopsis of the proceedings and the statistics relating to membership, museum, lectures, etc., were prepared by Mr. J. H. Paarmann, and the index by Mr. John Andreas Udden.

Since beginning Volume IX. the Publication Committee has suffered an irreparable loss in the death of its chairman, Mrs. M. L. D. Putnam.

When, in 1875, the ambitious project of publishing the Proceedings of the Academy was first talked of, it was Mrs. Putnam who found the ways for its accomplishment. She formed the Women's Centennial Association of Davenport, and interested its members in paying the expenses of the first volume of Proceedings by entertainments and other means. In 1876 the completed volume was taken by her to Philadelphia and deposited in the Woman's Building at the Centennial Exposition, as a sample of what the women of the West could do for science.

The next four years were a trying period in the life of the Academy. From abroad came words of praise and encouragement, but there was no endowment, and the money for the succeeding volume was raised dollar by dollar, patiently and indefatigably, through the efforts of Mrs. Putnam. After the death

of her son, J. Duncan Putnam, in 1881, Mrs. Putnam felt that the publication of the Proceedings, a project ever near her heart, was left to her as a special legacy. The loss of the inspiring presence of Mr. Putnam, who had put into his work the enthusiasm of a soul who knew that the years, even months, of his life here were numbered, and the death of many of the founders of the Academy, reacted in a discouraging manner. But Mrs. Putnam's activity never ceased. No difficulties daunted her, and with the kindly coöperation of the community there came out volume after volume of the Proceedings.

Brighter times came in 1895. Mrs. Mary Putnam Bull of Tarrytown, New York, left to Mrs. Putnam a legacy of \$10,000 for a memorial to her brother, Charles E., and her nephew, J. Duncan Putnam. Unhesitatingly Mrs. Putnam decided to devote this gift to an endowment for the publication of the Proceedings, feeling that this would be a living monument.

Mrs. Putnam died suddenly on February 20, 1903. Her last work, as she would have wished, was for the Academy. The afternoon of that day was spent at an exhibition of Indian baskets, for its benefit, and as usual she was the life and inspiration of the company. As the evening shades deepened she returned to her home, lay down to rest, and passed painlessly on to the Final Rest. In her will she left her entire property to this institution. Feeling that the needs of the museum would appeal to the friends of the Academy, she gave her legacy mainly to the endowment of the publication fund, making an aggregate sum of nearly \$24,000, the greater part of the income from which will be available for the printing and distribution of the Proceedings.

In the planning of the present volume Mrs. Putnam took a deep and active interest. She was especially gratified that it should contain, among other papers, one by Dr. Samuel H. Scudder, he being one of the last survivors of the group of eminent entomologists who, more than a score of years ago, recognized the work of the young J. Duncan Putnam and welcomed him to their midst.

Volume X. will be a memorial to Mrs. Putnam, containing her biography, with scientific papers by a number of her old friends.

In continuing the publication of the Proceedings the Academy hopes to maintain the same enthusiasm as in the past, and trusts that its work may be kept up to the high standard established by its founders.

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REV. WILLIS HERVEY BARRIS, D. D.

BIOGRAPHICAL SKETCH.

BY EDWARD S. HAMMATT.

The biographical sketches of the life of Rev. Willis Hervey Barris, D. D., by his long-time friends, Dr. Charles A. White of the Smithsonian Institution, for the October, 1901, number of the *Annals of Iowa*, that by Dr. Charles H. Preston of the Davenport Academy of Sciences, for the *American Geologist* of December, 1901, and an appreciative notice by Rev. Alfred A. Butler, D. D., warden of the Seabury Divinity School, in the *Living Church* for June 29, 1901, are all written with such loving sympathy for the true character of the man they portray that but little can be added in a brief record of his life. Yet, as the requirements of the Davenport Academy of Sciences prevent republication, we will again recall the main incidents of his career, and in so doing will take the liberty of quoting freely from these articles.

Rev. Joseph S. Barris, the father of Willis Hervey Barris, was a Methodist minister in Pennsylvania, a man of very decided opinions and not afraid to announce them. This characteristic trait was seen in his pronounced abolitionist views on the slavery question, which led to his withdrawal from the Methodist fold, and to his becoming a minister in the Congregational church. His upright, sturdy personality and the quiet, simple lives he and his family led, won for them the esteem and love of the community in which they dwelt. His wife's name was Mary Pepard, and they were living at Brush Creek, Beaver County, Pennsylvania, at the time of the birth of their son, Willis Hervey Barris, on July 9, 1821. Of his boyhood life we have only slight information. He was kept closely at his books and allowed very lit-

the time for recreation, which resulted in our finding him reading Virgil at nine years of age, and five years later, in 1835, entering upon his college career at Alleghany College, Meadville, Pa. From this institution he graduated in 1839 with the degree of A. B. In the same year he began a post-graduate course in civil engineering at Alleghany College, taking the degree of C. E. in 1841. It was his desire to take the military course at West Point, but his father promptly vetoed the plan, and so we find him working at civil engineering during the year following his graduation. Of his student record at Alleghany College, Dr. John Barker, its President in 1858, wrote: "His career at college had been equally honorable to the college and himself, and that he was an excellent scholar in every department of the college course, with a decided penchant for scientific pursuits." Dr. Charles A. White also notices the boy's interest in biological studies at a time when such studies were scarcely known. He says: "At the time of his graduation the study of geology and that of biological sciences were not included in the curriculum of any American college: but, as a boy, he became deeply interested in those studies and as he grew up to manhood that interest developed into mastery of several branches, of which geology and paleontology were his favorites, and in which he prosecuted original studies with marked success." We also find him giving his attention to physics, for he once told the writer that when Daguerre, in 1839, described his method of fixing a camera image on a sensitized copper plate, he became greatly interested in the subject and at once began making experiments with daguerreotypes, which were among the earliest made in this country. Records show that Dr. Barris was in Cleveland, Ohio, in 1841, and had a studio in the Franklin Building, corner of Water and Superior streets, where he was successful in making excellent daguerreotypes.

In the year 1842, at the age of twenty-one, he began his theological studies at the General Theological Seminary in New York, the oldest Protestant Episcopal Seminary in the United States. He completed the course in 1850, was ordained deacon and entered upon his chosen work as assistant to Rev. Henry Washington Lee at Saint Luke's Church, Rochester, N. Y. On Sep-

tember 19, 1852, he was ordained priest by Bishop DeLancey of New York. The following year he received his first charge as rector of Trinity Church, Brockport, N. Y. It was while in this parish, in 1855, that he yielded to the earnest solicitation of Bishop Lee and accepted a call to Trinity Church, Iowa City. Bishop Lee called to see him and found him confined to his bed with geological books opened around him. Pointing to a plate of beautiful fossils from the Burlington limestone, he said, "Bishop, I should like to go there," a wish which was gratified in later years. It was at this time that Alleghany College conferred upon him the honorary degree of A. M.

He went to Iowa City where he remained until 1859, when he accepted a call to Christ Church, Burlington, Iowa, where he carried on his parish work until 1866. In that year he was called to the Ely professorship of Ecclesiastical History (including Greek and Hebrew) in the theological department of Griswold College at Davenport, Iowa.

Mr. Ely was a warm friend of Dr. Barris and this chair was endowed mainly with reference to securing him as its occupant, and he was given a life tenure of Ely House, which was built for him. He filled this position with great honor to the college for twenty-five years, giving the best period of his life to this work. Of the work of these years, Dr. Alfred A. Butler, a pupil of his at that time, states: "Dr. Barris was one of the few men born to teach and to be admired and loved by those who are taught; yet neither his innate ability nor his great scholarship ever tempted him to enter the class-room without special study. More than one student who had neglected his books was shamed into faithful work by the knowledge that his professor had spent more time on the lesson than himself. Broad in his sympathies, comprehensive in his grasp of truth, he was the most helpful man I ever met."

In 1858, while at Iowa City as rector of Trinity Church, he was elected and served on the Board of Trustees of the Iowa State University.

In 1869 Griswold College recognized his ability by conferring upon him the honorary degree of Doctor of Divinity. The same year he was elected rector of St. John's Church, Keokuk, and in

1870 was elected rector of Trinity Church, Davenport. Neither of these calls was accepted, although he frequently officiated at Trinity Church, Davenport. In 1873 the Chair of Geology at Iowa State University was tendered him and he was strongly urged by scientific friends to accept, but he modestly declined, saying, "Paleontology is my play, theology my work." At the time of the election of the second Bishop of Iowa he was urged by his former pupils from all parts of the state to allow his name to be placed in nomination: they even consulted his physician as to the probable effect on his health. The following clipping, taken from a paper at the time, well expresses the universal feeling in regard to him:

"If the Rev. Willis H. Barris, D. D., one of the Professors of Griswold and at present President of the Standing Committee of the diocese, had not such a sincere distrust of his physical powers and mental qualifications as to shun the use of his name, it does seem to us he could be selected with great unanimity. This gentleman, however, in the estimation of his friends, embodies the very qualities most desirable for the exalted station of Bishop. Of great and varied scholastic attainments, possessing a Christian character noted for its integrity, firmness and simplicity, with an address that wins to him lovingly all Christian people by reason of his inspiring goodness, we cannot help wishing that the way may be so opened and his conduct so ordered, as to make him the successor of the universally esteemed and gifted Bishop Lee."

Notwithstanding such strong inducements he refused his consent, saying that he was a teacher and had not the necessary executive ability for that office.

Dr. Barris, at the time of his death, was the oldest resident clergyman in the Episcopal diocese of Iowa, having served faithfully in many important positions for nearly half a century.

He was for twenty-five years President of the Standing Committee of the diocese, and several times represented the diocese as a delegate to the General Convention. He was the first dean of Grace Cathedral, also Registrar of the diocese to the date of his death, and one of the incorporators of the Iowa Christian Home, and when that institution became St. Luke's

Hospital he was made a trustee. He was for many years Examining Chaplain of the diocese, and only a few weeks before his death gave a student a most vigorous examination in Greek and Hebrew, showing that his brilliant mental faculties were in full force to the last.

In 1877 the Trustees of Seabury Divinity School unanimously elected him Professor of Exegesis. The late Bishop Whipple, realizing the advantage of having a man with such character and attainments at work in his diocese, urged him to accept this chair, making a strong personal appeal to him. Dr. Barris felt, however, that he could not desert the work he had undertaken and so remained at the head of the Theological Department at Griswold College. In after years it was a source of much gratification to him that one of his former pupils, Dr. Alfred A. Butler, a thorough student, was faithfully and efficiently filling the warden's chair at Seabury.

Although Dr. Barris had no parish charge in Davenport, he was so personally beloved that many of the older families of the city called upon him for religious offices as long as he was able to supply them. When he became too feeble to perform such duties it was touching to see his deep regret that he could no longer help and comfort old friends in trouble.

Eminent as he was in his chosen field of theology, we cannot but feel that science should not have been deprived of work he could have done in his beloved study of paleontology. We have seen how the scientific proclivity first became noticeable in his college studies, and we know that he began collecting fossils while located in his first ministerial charge at Brockport, N. Y.

These early geological excursions to "Ten Mile Creek" were often recalled with pleasure. On coming to Iowa City he found an interesting geological field in the Devonian formation of the Iowa River Valley.

In moving from Iowa City to Burlington, his early wish, expressed to Bishop Lee, was realized, for he found himself among the Burlington limestone quarries, rich in fossils, and especially so in the most beautiful of fossil forms, the crinoids. He at once began a thorough investigation of these fossils, of which he made extensive collections. Portions of these collections were sent to the

British Museum, the authorities of which institution wrote very complimentary letters in reference to his work, and as a further proof of their appreciation the trustees of the museum sent him a copy of the great work of Etheridge and Carpenter, entitled, "A Catalogue of Blastoidea" (London, 1866). The authors mention Dr. Barris next to Dr. Wachsmuth, as first among their scientific friends at home and abroad, to whom they expressed their indebtedness. In the summer of 1866 Dr. Barris received a visit from Prof. and Mrs. Louis Agassiz, who made this visit for the express purpose of seeing his collection of crinoids. Prof. Agassiz was so pleased with the collection that he negotiated the purchase of it for the Museum of Comparative Zoology at Cambridge, Mass. In a subsequent letter to Dr. Barris, Prof. Agassiz wrote: "I owe it to you to say that I shall treat this collection with all the regard it deserves and that I shall take good care to have the scientific world know and understand that, while it will become an ornament to the museum at Cambridge, it is yet entirely your work. Every specimen will be furnished with a label stating that it once formed a part of your collection, and I believe I am within bounds in saying that it will commemorate your scientific zeal and ability as surely as it would remaining in your possession. Allow me to request you, therefore, not to feel as if you had parted with your interest in science, but, on the contrary, to continue your efforts in a direction in which you have thus far been so eminently successful."

Of these crinoids many were new species discovered and described by Dr. Barris. While Wachsmuth and Springer, in their great monograph on the crinoids, Etheridge and Carpenter, Hall and other geologists, used type specimens from his collection, which he was very generous in loaning. Parting with his collection to Prof. Agassiz only served to increase his zeal as a collector of fossils, for another collection was immediately begun, not only of the Burlington fossils, but year by year he made as many as ten excursions to the fossil beds of Northern Michigan, each time bringing back choice specimens found only in that locality.

An incident may be mentioned to show his intense absorption when fossilizing. One of the favorite Michigan fossil beds was

located under an overhanging cliff, and the fossils could only be reached by wading. On this particular day the water was very cold and he said to himself, "I must not stay in the water more than fifteen minutes." He looked at his watch to time himself; it was nine o'clock. When he supposed the fifteen minutes had passed he looked again; it was twelve o'clock!

At another time, when nearly seventy-five years of age, while exploring the ravines below Davenport, he sprained his ankle, yet so intent was he on his search for fossils that he forgot his injury until three ravines had been thoroughly gone over.

He had a lively sense of humor, even though it was at his own expense. At one time a man representing himself to be a geologist and deaf and dumb, called to see his fossils. Conversation was carried on by means of pencil and paper. The man exhibited a familiarity with fossils and was shown the collection. Soon Dr. Barris detected him slipping a fossil into his pocket, and as another was disappearing, Dr. Barris ejaculated aloud, "Confound the fellow, there goes another fossil;" and in the course of the interview a number of specimens disappeared. When asked why he did not make the rascal give them up, he said, "Why, the fellow seemed so fond of them I could not ask him to part with them." This same imposter afterwards appeared in several places in the same role, and as he proved to be neither deaf nor dumb, probably enjoyed the humor of the situation quite as much as the doctor.

At the time of his death Dr. Barris considered his collection of more scientific value than that placed in the Cambridge Museum.

It is interesting to know that while living in Burlington Dr. Charles A. Wachsmuth was in such poor health that his physician asked Dr. Barris to take him with him on his geological excursions, in the hope that he might prolong his life by interesting him in some out-door work. They made many long excursions together, Dr. Wachsmuth thus getting his first insight into geology. The work soon grew to be of great interest to him and was taken up as a life work, making him, as years went by, a world-famous paleontologist. This intercourse was kept up by a life-long correspondence between the two men. Among the strongest ties that bind men together is that of mutual scien-

tific interest. In Dr. Charles A. White, Dr. Barris found a most congenial companion. Making excursions and working together among the Burlington crinoids, a friendship grew up between them, and when Dr. Barris went to Davenport and Dr. White was called as paleontologist to the Smithsonian Institution at Washington, this friendship ripened and strengthened as the years went by.

On taking up his residence in Davenport Dr. Barris began to familiarize himself with the local geology of Scott County. The results of these investigations were given in valuable papers which he contributed to the reports of the Geological Survey of Illinois and the Proceedings of the Davenport Academy of Sciences. This latter institution was founded in 1867, and at the first meeting Dr. Barris was elected a Trustee, and continued to serve as Trustee and member of the Publication Committee for many years. In 1876 he was elected President and later he was made a life member of the Academy through the kindness of Mrs. Mary L. D. Putnam. The portrait which forms the frontispiece to this volume was taken in 1876, while Dr. Barris was President of the Academy. His eyesight had long troubled him through too close application to his Greek and Hebrew text, and in 1890 he was obliged to relinquish most of his theological work. It was at this time that he became Curator and Corresponding Secretary of the Academy of Sciences. In 1892 he was appointed a member of the Advisory Council of the International Congress of Geologists, held during the World's Columbian Exposition at Chicago, Prof. Samuel Calvin and Dr. Charles Wachsmuth being the only other geologists appointed to represent the State of Iowa.

Although nearing his eightieth year, he continued to serve the Academy faithfully till within a few days of his death, which occurred at his home at Ely House, Davenport, June 10, 1901.

The family records show that Dr. Barris was married October 7, 1840, to Miss Caroline M. Harrison of Meadville, Pa. She died in 1850, leaving him with two daughters, one of whom, Mary Elizabeth, is living, and is the wife of Rev. S. R. J. Hoyt, D. D., of Davenport. His second marriage took place at LeRoy, N. Y., on May 9, 1854, to Miss Caroline P. Rathbone, who was a most

devoted and helpful companion through the many years of their married life, taking a keen interest in all his work and study. She survives him with three daughters, Carrie Rathbone, the wife of Mr. Edward S. Hammatt of Davenport, Miss Amanda Ganson and Miss Elizabeth Lovering Barris. The Davenport Academy of Sciences, in its resolutions of respect, paid the following fitting tribute to his memory: "Of a gentle and scholarly disposition, holding close and loving communion with Nature's visible forms and their informing Spirit, he had neither time nor inclination for business strife with his fellow men. The soul of kindness in every relation of life, he made each one who came to know him a friend." Dr. Charles H. Preston thus speaks of him in the *American Geologist*: "To the writer, who knew him well, he embodied the highest ideal of kindly, courteous and Christian manhood. In him were united a soul pure as a child's, the modesty of great wisdom, and the simple dignity of a gentleman of the old school."

Dr. Charles A. White writes of him in the *Annals of Iowa* "As leading a life of such usefulness to mankind, such devotion to high principles, and of such value to the State of Iowa, of which he was a citizen for forty-six years, as to make it fitting to have a record of his life in the *Annals*." He further says: "It was my good fortune to secure his confidence and my privilege to call him my friend during more than forty years; and I never had an interview with him or received a letter from him that did not add to the sum of my life's enjoyments, to my stock of knowledge and to my confidence in humanity. He was an ideal friend and eminently useful citizen, a profound scholar, a most efficient teacher and a devoted Christian minister. The memory of such a man is a blessing to the state." The writer being closely associated with him for years as a member of his family will ever think of him with grateful remembrance; of his firm, gentle, sympathetic nature, always showing such kindly interest in others that no one could come in contact with him without being the better for it. Those who knew of him revered him, those who knew him loved him, those who knew him as a friend found that friendship worth living for.

A FIRST LIST OF THE ORTHOPTERA OF NEW MEXICO.

BY SAMUEL H. SCUDDER AND THEODORE D. A. COCKERELL.

The only attempt that has been made at any systematic presentation of the Orthoptera of a southwestern State or Territory in the Republic was given in a paper in *Insect Life* (vi., 29-32) by Townsend on "The Injurious and Other Locusts of New Mexico and Arizona," in which thirty-four Acridiidae were listed, of which all but five were credited to New Mexico. Collecting in the territory has been desultory rather than systematic, and therefore this first attempt to collate what has been published and to add to it such new material as has been made available cannot expect to be nearly complete. It is probably least so in the Locustidae; but it is hoped that the publication of this list will stimulate a closer study of the native fauna, since the number of forms undiscovered must still be considerable.

The paper being a joint one, it is well to point out that the introductory remarks that follow upon the physiography and faunal districts of New Mexico are entirely written by the junior author, long resident in the Territory, and those comparing the orthopteran faunas of New Mexico and New England, by the senior author. The identification and description of species is also the work of the latter, based mainly upon material supplied by the junior author, who is also responsible for field-notes not otherwise credited.

DISTRIBUTION WITHIN NEW MEXICO.

Within the boundaries of New Mexico there exists the greatest diversity of altitude, and therefore of climate. A line drawn from the northeast to the southwest corners divides the Territory diagonally into two parts, of which the northwestern half is mostly above 6,000 feet, while the southeastern is mostly below that level. Most of the latter portion is in reality a continuation of the staked plains, and possesses, to a certain extent, a genuinely Texan fauna. As an example of this

we may cite the occurrence of the snail *Polygyra texasiana* at Roswell, where it was found by Prof. J. D. Tinsley. This lower eastern portion of New Mexico, including principally the counties of Union, Guadalupe, Chaves and Eddy, has unfortunately not been explored for Orthoptera since the time of Capt. Pope, who secured a number of species there without noting exact localities.

Passing westward, we find in the counties of Lincoln and Otero, still east of our diagonal line, a considerable group of mountains, consisting of the White Mountains, the Sacramentos, and the Capitans. These have a fauna and flora possessing some peculiar features, and from the first two ranges we know a good many Orthoptera, as will be explained below. Immediately to the west of Otero county is Doña Ana county, in which are the Mesilla Valley and the Organ Mountains, only about 40 miles north of the Mexican boundary.

The other half of New Mexico is mountainous, with many more or less isolated ranges. If one gives a certain color to all the elevations over 8,000 feet, the map of New Mexico presents the appearance of an archipelago, and I have used the term "boreal islands" to indicate the isolated elevations. To the north, indeed, coming down to within sight of Las Vegas and Santa Fé, is a high range which extends continuously up into Colorado, and has on its summit a typically Hudsonian fauna and flora. South of this, however, the boreal faunæ, so far as they exist, are everywhere isolated, and there is a consequent development of insular types, as it were. Unfortunately, comparatively few of these "islands" have been explored at all by the entomologist, and none have been exhaustively examined, so that we really know very little about them. However, putting together the available data regarding plants, snails and insects, we can affirm that peculiar forms have been evolved, and can rest assured that further exploration will bring forth facts of the highest interest.

THE LIFE-ZONES.

Five Life-zones are recognized in New Mexico, as follows:

(1.) *Middle Sonoran.* Altitudes below 5,000 feet in the extreme south, including the Mesilla Valley and Deming. For a consideration of the differences between this and the Lower Sonoran, see *American Naturalist*, April, 1900.

(2.) *Upper Sonoran.* Altitudes from 4,500 or 5,000 ft. to about 6,500, varying according to latitude and exposure. Here I have

included Albuquerque, Silver City, Chaves, Organ Mountains, Raton, Las Vegas, etc.

(3.) *Transition*. About 7,000 ft. Including Santa Fé, Las Vegas Hot Springs, and a considerable part of the Sacramento Mountains.

(4.) *Canadian*. About 8,000 ft. to 10,500. Includes Beulah and Agua Fria Park.

(5.) *Hudsonian*. About 11,000 ft.; on the top of the Las Vegas range ("Sapello Ridge.") Taos Peak, 13,000 ft., is properly *Arctic-Alpine* (i. e., above timber line), but it is a very small area in New Mexico.

The zonal distribution of species and genera is most interesting, and it is surprising how sharply defined the zone-faunæ are on the mountain slopes. It results from this that the citation of the nearest town or post-office as the locality of specimens may often be extremely misleading, and a great deal of perplexity and annoyance is caused by collectors, who do not label their material with satisfactory data. It is better to cite no locality at all than to say a thing came from a certain place when it was really from a thousand feet higher and in another zone!

To test the validity of the Life-zones for insects I have chosen the wild bees, because they have been more closely collected than any other insects in New Mexico.

I find 414 species of bees recorded from the territory. These are distributed in the zones as follows:

Middle Sonoran	216	Canadian	58
Upper Sonoran	162	Hudsonian	11
Transition	117		

It will be seen that there is a very regular decrease (44 to 59 to the zone) as we go upwards. Only 153 species have been taken in two or more zones. The inter-zonal range of species is as follows:

Middle Sonoran to Upper Sonoran	66
" " " Transition	28
" " " Canadian	4
" " " Hudsonian	0
Upper Sonoran to Transition	62
" " " Canadian	11
" " " Hudsonian	0
Transition to Canadian	23
" " " Hudsonian	3
Canadian to Hudsonian	6

The percentage of Upper Sonoran species (38%) given as ranging to the Transition is slightly greater than it should be, because I have counted Las Vegas as Upper Sonoran, while it is somewhat tinged with Transition.

Of course, every season's collection will modify the above figures, but it is believed that the bees have been sufficiently collected to afford results which are reliable in their broad features.

As regards genera, the most noticeable thing is the presence in the Middle Sonoran of several distinctively southern or southwestern genera, not or hardly extending further. Such among the bees are the following:

Sphcodogastra, Ashm. One species; Middle Sonoran.

Callandrena, Ckll. One species; Middle Sonoran.

Hesperapis, Ckll. Three species; Middle Sonoran.

Perdita, Smith (sens. lat.). Sixty-nine, of which thirty-five are only Middle Sonoran, and none go above the Transition.

Ericrocis, Cress. One species; Middle Sonoran.

Bombomelecta, Patton. Three species; Middle Sonoran.

Exomalopsis, Spinola. Four species; Middle Sonoran, but two of them go to Upper Sonoran.

Centris, Fabr. Six species; Middle Sonoran.

Protoxaea, Ckll. and Porter. One species; Middle Sonoran.

These find a parallel in such orthopterous genera as *Homocogamia*, Burm., *Bacunculus*, Burm., *Boottettix*, Bruner, *Clematodes*, Scudder, and *Hormilia*, Stål, all found in the Mesilla Valley.

DISCONTINUOUS DISTRIBUTION.

Many animals, such as mammals (exclusive of the bats), snails and the apterous Orthoptera, have to extend their range by pedestrian means, and thus usually occupy a perfectly continuous territory. When their distribution is discontinuous it may have become so in such ways as the following:

(1.) The species may have once occupied the whole of the territory between the most distant points of its occurrence, but have become extinct in the intermediate area.

(2.) The species may have been first divided as in the instance just supposed, and then the two or more separate portions may have extended their range, e. g., moved up the mountains in consequence of an ameliorated climate.

(3.) Individuals of the species may have been carried by man or some other occasional agency to a distant spot, and have formed an isolated colony.

The majority of the Orthoptera, however, are capable of flight, and some are to a high degree migratory. Suppose a species to occupy a given area, it is probable that every year a certain number of individuals will cross the normal boundary lines, and find themselves in a strange country. Most of these migrating individuals will probably perish, and the fact that *Melanoplus spretus* has never become established in New Mexico is sufficient proof that mere migration, even in countless numbers, will not necessarily insure the founding of a colony.

Occasionally, however, it may be fairly supposed that one or more wandering females will succeed in depositing eggs, which will give rise to a colony which may become permanent. In this way will be established colonies of Orthoptera at varying distances from the original habitats of the species, the intermediate country being unoccupied.

An examination of the records seems to indicate that what might thus have been expected has actually taken place. Every locality from which we have more than a very few records has one or more species not found in other places in New Mexico. But many of these species are of wide distribution elsewhere, and cannot be supposed to have originated where we now find them. Their apparent restriction to limited areas may in many cases be due to inadequate collections, but there are some cases, at least, in which this explanation appears improbable. Such are the following:

(1.) *Melanoplus thomasi*, abundant at Tularosa; not found in the Mesilla Valley, which has a similar climate and elevation. The insect is a very conspicuous one, not easily overlooked. The only other locality known is in the state of Durango, Mexico.

(2.) *Hippiscus pardalinus*, abundant at Las Vegas; not observed elsewhere in New Mexico; also a very conspicuous species. Out of New Mexico it extends to California, Nevada and Utah.

(3.) *Aulocara elliotti*, abundant at Johnson's Basin; not seen elsewhere in New Mexico. Extends to Texas, Wyoming and the Pacific.

(4.) *Mermiria texana*. The colony at Las Vegas Hot Springs seems to be isolated from the general range of the species.

When isolated colonies are thus formed, it is probable that in most cases modification will slowly take place, resulting eventually in the development of distinct species. This will result partly from differ-

ences in the environment, and partly from the fact that the individuals starting the colony are likely to possess peculiarities which will be transmitted to their progeny, free from the swamping effects of intercrossing with the main body of the species. It would be of great interest to secure large quantities of any isolated colony of a species, and determine by measurements and other detailed comparisons whether there was an average or absolute deviation from the characters possessed by the main body of the original locality.*

The same phenomenon doubtless occurs among other flying insects. The beautiful butterfly *Argynnis nitocris nigrocarulea* appears to be confined to an area of a few square miles in the Sapello Cañon, New Mexico, repeated search in the upper parts of Sapello Cañon, and a summer's exploration by the University of Kansas party in the adjacent Gallinas Cañon, having failed to discover it. Elsewhere, the *nitocris* type occurs in northern Arizona, and a very distinct form in the Sierra Madre of Chihuahua, but all the known colonies of the butterfly are widely separated, and they have so far diverged from one another as to be practically distinct species.

In some instances, it may be that a colony first isolated may spread so as to become reunited with the main body of the species. Or two colonies, at first separate, may become united. In such instances, if the colonies have undergone any divergent evolution, it is possible that they may fuse with the result of losing their distinctive characters, or forming a new average different from both. Such fusion of already distinct varieties is likely to lead to great variation, with the appearance of atavistic peculiarities (see *Science*, March 15, 1901, p. 423). I am not aware that any such phenomena have been demonstrated among the Orthoptera but they may be looked out for. As an illustration of what may occur, I will take the malvaceous genus *Lavatera*. Off the coast of Southern and Lower California are various islands, certain of which possess endemic species of *Lavatera*, as thus:

L. venosa; San Benito Islands, San Geronimo Island.

(*L. venosa*, variety, grows at San Bartolomé Bay.)

L. insularis; Coronado Islands only.

L. occidentalis; Guadalupe Island only.

Last summer I had the pleasure of seeing the garden of Mr. and Mrs. Dandegre at San Diego, Calif., in which these *Lavateras* are

* In *Science Gossip*, 1900, p. 367, will be found an account of such deviation in the Salt River Valley line, of *Metastaphylea* species, the statistics based, however, on too few individuals.

growing freely. As Mrs. Brandegee pointed out to me, there are some new seedling plants which cannot be referred to any one of the three species, and are apparently hybrids (see also *Zoe*, July, 1900, p. 25). Isolated on the islands, the plants have developed peculiarities which we regard as specific, but have had no need for physiological barriers against crossing. Brought together on the mainland, they at once become hopelessly mixed. The same phenomenon appears when *Aquilegia carulea* and *A. chrysantha*, naturally inhabiting different groups of mountains, are grown together in gardens.

ENDEMIC SPECIES.

Most of the New Mexico Orthoptera are of more or less wide distribution, but it is possible that we have some truly peculiar species, especially among those which are apterous or subapterous. The following are suggested as probably endemic:

- (1.) *Trimerotropis cyanea*; Organ and White Mountains, the range corresponding to that of the beautiful *Rosa stellata*, Wooton.
- (2.) *M. cockerelli* and *M. sapellanus*; top of Las Vegas range.
- (3.) *M. neomexicanus*; Las Vegas. Short-winged.
- (4.) *M. quadratus* and *M. calidus*; White Mountains. Short-winged.
- (5.) *M. snowi*; Magdalena. Short-winged.

It seems not unlikely that every one of the "boreal islands" of any size will be found to exhibit one or more peculiar forms of brachypterous *Melanoplus*. It may be, also, that *Ceuthophilus* will exhibit a somewhat similar local diversity.

FOOD PLANTS.

While many of the Orthoptera are polyphagous, many are almost or wholly restricted to certain food plants. Certain of the latter are beautifully modified in color or otherwise to resemble their surroundings, as is seen in the two *Larrea* species, *Boottettix argentatus* and *Clematodes larreae*. One of the characteristic desert plants, *Atriplex canescens*, grows abundantly on the campus of the Agricultural College at Mesilla Park, and the writer had plenty of opportunity for studying its special fauna. It is a large greyish-green bush, with curiously winged fruits; a closely allied species with narrower leaves (*A. angustior*, Ckll. = *Obione occidentalis angustifolia*, Torrey, Bot. Mex. Bound, 184, nom. preocc.) is found on the sandhills a mile away.

As an example of the insect-fauna of a desert shrub, I will cite the species pertaining to *Atriplex canescens* in the Mesilla Valley, all known to breed on the plant except the Orthoptera, some of which, at least, may deposit their eggs in the soil beneath.

LEPIDOPTERA: *Lycæna exilis*, Boisd.; *Coleophora atriplicivora*, Ckll. The last is a case-maker.

DIPTERA: *Diplosis atriplicicola*, Ckll.; *Lasioptera willistoni*, Ckll.; *Asphondylia atriplicis* (Townsend.); *A. neomexicana* (Ckll.). These are all gall-makers.

COCCIDÆ: *Orthezia annæ*, Ckll., *Loccaniodiaspis rufescens* (Ckll.); *Ceroplastes irregularis*, Ckll.; *Eriococcus neglectus*, Ckll.; *E. tinsleyi*, Ckll.; *Phenacoccus solenopsis*, Tinsley; *Dactylopius atriplicis* (Ckll.); *Mytilaspis concolor* (Ckll.). Another Coccid, *Solenococcus coloradensis* (Ckll.), has been found on *A. canescens*, but in Colorado only.

ORTHOPTERA: *Acrolophus elegans*, Scudd.; *Dichopetala emarginata*, Brunn.; *D. brevicauda*, Scudd.; *Plagiostira albofasciata*, Scudd. and Ckll.

DISCUSSION OF THE LOCALITIES.

MESILLA VALLEY.

This includes the localities cited as Mesilla, Mesilla Park, Las Cruces, and Little Mountain. It is a broad, open valley, through which flows the Río Grande. The central portion, or valley proper, is alluvial, and has an altitude of about 3,800 ft. It consists partly of sand-hills and partly of adobe soil, the latter being mostly under cultivation. Although the sand and adobe are adjacent to one another, they support very different plants, and in consequence, different insect-fauna. In the cultivated fields the most prominent Orthoptera are certain species of *Melanoplus*, *M. differentialis*, *M. femur-rubrum*, *M. atlantis* and *M. lakinus*. On the trees in the orchards one finds *Planethus* and *Microcentrum*; while *Gryllus* inhabits the ground beneath, and is seen at times stampeding before irrigation waters. The sand hills are the home of quite other species; some, like *Melanoplus herbaceus*, colored green like their food-plants; others, like certain of the *Trysalines*, the color of the sand. The sides of the valley,

gradually sloping upwards, consist of gravelly soil, and support again a different fauna and flora. The bottom of the slope adjacent to the valley-bottom, is covered with *Atriplex canescens* and mesquite (*Prosopis glandulosa*), and is golden in the early fall with the flowers of *Bisclevia* or *Isocoma heterophylla wrightii*. A little higher up, commencing as abruptly as if planted, begins the *Larrea*, which covers many miles of country, giving it an olive-green tint sharply contrasting with the grey-green of the *Atriplex*. It is in this *Larrea*-zone, especially, that we meet with southern types. The bottom of the valley is colder than the sides, owing to the downward flow of the cold air, or upward flow of the warm, and the latest spring frosts are always at the very lowest levels. Little Mountain, or Tuerto Mountain, is a small rounded elevation in the midst of the *Larrea*-zone.

In all, sixty-nine Orthoptera are recorded from the Mesilla Valley; a much larger number than from any other New Mexico locality.

ORGAN MOUNTAINS.

These mountains flank the Mesilla Valley on the east. The Orthoptera recorded for them have been collected at Fillmore Cañon, La Cueva and Dripping Spring, at elevations ranging from 5,000 to 5,800 ft. or thereabouts. These localities are very rocky, tolerably dry, and shaded to a considerable extent by trees and bushes of the genera *Quercus*, *Celtis*, *Garrya*, *Prunus*, etc., which do not occur at all in the valley. Thirty-two Orthoptera have been taken, of which only seven have been found also in the Mesilla Valley. The same degree of difference is found in the case of insects of other orders.

SACRAMENTO MOUNTAINS.

Going northwest from the Organ Mountains about fifty miles, we come to the Sacramentos, rising abruptly from a grassy plain. At the foot of these mountains, but not in them, are the towns of Tularosa and La Luz, where a few Orthoptera have been taken. From Tularosa the road runs up to the Mescalero Indian agency, which is on the very borderland of the Upper Sonoran and Transition zones. Nine miles up the road from Tularosa, at an elevation of about 5,000', is Little Round Mountain, where Wooton collected several Orthoptera, the new plant, *Hesperaster perennis*,* and at the flowers of the latter the new bee *Perdita wootonæ*.

* *Mentzelia perennis*, Wooton, 1898. *Hesperaster* is *Bartonia*, Nutt. (preocc), as I have set forth elsewhere.

For a list of bees collected at Mescalero, see *Entomologist*, June, 1899, p. 156. For a general discussion of the Sacramento and White Mountains, with many insect records, see Townsend, *Trans. Texas Acad. Science*, June, 1897, pp. 51-57.

WHITE MOUNTAINS.

These consist of Sierra Blanca (11,092 ft.) and the elevated country immediately adjoining, including the localities recorded as Eagle Creek, Rio Ruidoso, and Ruidoso. These mountains are essentially continuous with the Sacramentos, representing a more elevated, northern extension of that range. They have a somewhat peculiar fauna and flora, among the most interesting being several endemic forms of *Ashmuneila*, a genus of snails. The most distinct of these, *A. altissima* (Ckll.), is confined to the summit of Sierra Blanca. Among the bees we may note *Andrena barberi*, Ckll. (a peculiar species, not taken elsewhere), and a great variety of *Bombus*, including *B. sonorus*, Say, originally described from Mexico. The plants include a peculiar elder (*Sambucus neomexicana*, Wooton), and many other interesting species. High up on Sierra Blanca is an endemic *Potentilla*, *P. sierræ-blancæ*, Wooton and Rydberg.

The Orthoptera collected in these mountains number twenty-one species. A striking feature is the occurrence of austral species at surprisingly high altitudes, for example, *Derotmema haydeni* at 8,000', a circumstance which is paralleled in other groups.* The boreal fauna is represented by *Circotettix undulatus* and *Tettix incurvatus*.

SILVER CITY.

This is in the northern part of Grant County, about fifty miles from the Arizona line. Fifteen Orthoptera have been recorded, of which seven have not been found elsewhere in New Mexico. There can be no doubt that this region possesses a certain individuality in its fauna and flora, combined with a tinge of Arizona types. This is made evident by the records of Coleoptera obtained by Snow on Walnut Creek, near Silver City, a large proportion of the species being not otherwise known from New Mexico. The Orthoptera reported merely from "Grant Co.," collected by W. J. Howard (the discoverer, in the same region, of the splendid moth, *Daritis howardi*, Hy. Edw.), must have come from different elevations; some, however, from the warm

* For instance, Townsend records the austral *Eristalis tricolor* from the Ruidoso.

southern part of the county. It is in this southern extremity of New Mexico that we find some striking Mexican types, such as snails of the genus *Holospira*, and the Orthopteran genus *Teniopoda*. A rich harvest undoubtedly awaits the Orthopterist who shall carefully explore this region.

VALENCIA COUNTY.

In 1892 Townsend made a wagon trip across this county, and collected various insects at La Vega de San José (Aug. 4), Chaves (Aug. 6), and Belen (Aug. 7). On Aug. 7 he also collected at Sabinal, which is about ten miles south of Belen, but in Socorro County. These places are all in the valley of the Rio Grande, some 150 miles north of the Mesilla Valley and thirty or forty miles south of Albuquerque.

JOHNSON'S BASIN.

Orthoptera were collected here by Townsend on June 23, 1892. It is in the extreme western part of Socorro County, west of Apache Springs, and not far from the Arizona line. Of the seven species taken, four are not otherwise recorded from New Mexico. For general particulars of the region, see Townsend, *Trans. Texas Acad. Science*, Vol. 1, p. 76. Magdalena, also in Socorro County, is in the mountains about twenty miles west of Socorro. Various insects were collected there by a Kansas University party.

ALBUQUERQUE.

Situated on the Rio Grande, in Bernalillo County, Lat. $35^{\circ} 05'$, altitude 5,026 ft. Eight Orthoptera are recorded, but the bees are somewhat better known (31 species). The Coleoptera have been collected by Wickham, and include a great many species not observed in the Mesilla Valley. The flora differs to a considerable extent from that of the Mesilla Valley, especially noticeable about the town being *Peritoma serrulatum*, *Anemopsis californica*, and *Bizelovia bigelovii*.

Of the 31 Albuquerque bees (only a fraction of what must occur there), 17 range to the Mesilla Valley, 9 to Las Vegas, and 7 to Santa Fé.

Among the Orthoptera, a larger proportion of Albuquerque (and indeed Las Vegas) species range to the Mesilla Valley than do those of the closely adjacent Organ Mountains. This is to be explained by the fact that the first three localities are in many respects similar—open and comparatively treeless: while the Organ Mountains are rocky and have many trees and shrubs.

GALLUP AND FORT WINGATE.

These are in the western part of Bernalillo County, not far from the Arizona line. The Fort Wingate material, obtained by Dr. Shufeldt, included two very interesting species of *Ceuthophilus*. There is no doubt that a good collection of Orthoptera from this region would contain many new or rare species.

LAS VEGAS.

In San Miguel County, with an altitude of about 6,400 ft. While at the base of the mountains, it is in comparatively open country, surrounded to a great extent by grassy, treeless mesas. Its fauna as a whole is Upper Sonoran, including some distinctively southwestern types, such as the moth *Hemileuca sororia olivæ*, Ckll., the males of which come in numbers to the electric lights in the early fall. Equally characteristic, in the spring, is the abundance of *Arachnis zuni*, Neum., a moth hitherto considered of the rarest.

Las Vegas has 77 bees recorded; Santa Fé (7,000 ft), which is considered Transition, has 71. There are 36 species common to these localities; that is, about half. Beulah, which is Canadian, has 45 bees, of which only six were found at Las Vegas, although the places are not thirty miles apart! The Mesilla Valley has 23 bees in common with Las Vegas.

Twenty-three Orthoptera are recorded from Las Vegas; of these, seven have been found in the Mesilla Valley.

Las Vegas Hot Springs, 7,000 ft., is only six miles from Las Vegas, and is classed as Transition. A good deal of confusion has been caused by collections from the Hot Springs (or further up the cañon) being reported as from "Las Vegas."

Trout Spring is in the Gallinas Cañon, some miles above the Hot Springs.

SANTA FE.

Altitude 7,000 ft., surrounded by mountains. Eleven or twelve Orthoptera have been collected.

LA TREMENTINA.

A Mexican settlement in San Miguel County, about 45 miles east of Las Vegas. Miss Alice Blake has collected there a number of Orthoptera, including the new genus *Eupelates*. The species are in the main those of the Upper Sonoran, but one (*Camnula pellucida*) is a boreal form

RATON.

In Colfax County, only a few miles from the Colorado line. The Orthoptera are much the same as those of Las Vegas, and the material so far obtained indicates nothing peculiar. Nevertheless, it is probable that more extensive collecting would reveal some additions to the fauna, as certain of the plants are entirely different from those of the Las Vegas region. These include some of the most conspicuous species, such as *Robinia neomexicana*, *Hesperaster decapetala* (*Bartonia decapetala*, Pursh, 1812), and *Delphinium robustum*. The last was only recently described by Rydberg, who cites "Ruton, Albert," meaning Raton, collected by Abert. I found it last year in Chicorico Cañon near Raton, and thought it probably new, before Rydberg's description appeared.

Robinia neomexicana, like the grasshopper *Leprus wheeleri*, is found both at Raton and in the Organ Mountains.

AGUA FRIA PARK.

This is an elevated country between 8,000 and 9,000 ft., in Colfax County, about thirty miles west of Springer. Mr. Emerson Atkins collected there a few Orthoptera, all alpine or boreal forms, similar to those found at Beulah. At the same time he obtained a series of the interesting mammal *Thomomys fessor*, Allen, new to the fauna of New Mexico.

BEULAH.

In the Las Vegas range, towards the upper part of Sapello Cañon; altitude about 8,000 ft. The fauna and flora are those of the Canadian zone. Although the Las Vegas range is practically continuous with the high mountains which in southern Colorado include the Sangre de Cristo, it is remarkable that both fauna and flora, while agreeing in general facies, present numerous differences from those of the latter mountains. Thus the common species of *Delphinium*, *Erysimum*, etc., are not the same in the two ranges. At Beulah the mountain-sides are covered with the beautiful *Leucampyx newberryi**, not seen in the Sangre de Cristo. At Beulah a snail of the genus *Ashmunella* abounds, but none of this genus occur in Colorado so far as known. These and other differences may be attributed in part to differentiation of types proper to the mountains, and partly to the invasion of the mountains by austral forms, which have become adapted to a boreal climate.

* The *Leucampyx* has, however, been reported from Soda Springs, thirty-five miles northwest of Cañon City, Colorado.

TOP OF LAS VEGAS RANGE.

Several visits have been paid to the top of the Las Vegas Range, between the Sapello and Pecos Rivers ("Sapello Ridge"), where the altitude is about 11,000 ft., and the fauna and flora are typically Hudsonian. Five species of Orthoptera were collected, three being of the genus *Melanoplus*. These latter were mature early in August, but about the first of July not a single one could be found mature, though an occasional *Circotettix undulatus* had reached that condition.

The flora of this alpine region is characterized by its small stature and bright flowers, though this is not without various exceptions. The open grassy land is gay with *Potentilla pulcherrima*, Lehm., *Dodecatheon pauciflorum* (Durand), *Arenaria biflora* (L.), *Erigeron liomerus*, Gray, and a large-flowered form of *Campanula rotundifolia*, L., while the common grasses are all of circumpolar types, namely *Festuca ovina*, L., *Trisetum subspicatum* (L.), *Poa nemoralis*, L., *Phleum alpinum*, L., and *Deschampsia cespitosa*, Beauv. "Everlastings" of the species *Antennaria rosea* (Eaton) and *A. microphylla*, Rydberg, grow in profusion in dry, stony places. Under and close to the tall spruce trees is a different flora, including for example *Dasiphora fruticosa* (L.), *Viola adunca*, Smith, and *Primula angustifolia*, Torrey. During the latter part of August my wife found fringed gentians (*Gentiana elegans*, A. Nelson) in full flower and great abundance. These live in damper spots, and other inhabitants of relatively damp ground are *Elephantella groenlandica* (Retz.), *Veronica wormskjoldii* R. & S., *Castilleja alpina*, (Porter), and *Caltha rotundifolia chionophila* (*Caltha chionophila*, Greene, described from the same altitude in Colorado). Most of these plants here find their southern limit, and are additions to the recorded flora of New Mexico.

Taos Peak, 13,000 ft., where Carpenter collected some Orthoptera, is on the eastern border of Taos County, in the northern continuation of the Las Vegas Range, there known as the Taos Range. From its elevation, it must have something of an arctic-alpine fauna and flora, similar to that of the summits of the Colorado mountains. It is best known to entomologists as the type-locality of the butterfly *Argynnis carpenterii*, W. H. Edw. No great distance from Taos Peak is South Baldy Peak, near Elizabethtown, in Colfax County. Mrs. O. St. John gave me a specimen of *Castilleja haydeni* (a plant which grows above timber-line in the Colorado mountains) which she collected at 12,000 ft. on this mountain, in 1898. It is much to be desired that the entomology of this peak should be made known.

THE ORTHOPTERAN FAUNA OF NEW MEXICO AND NEW ENGLAND COMPARED.

It will be interesting to compare the orthopteran fauna of New Mexico, a southwestern Territory, with that of New England, a north-eastern district, which though of only about half the size has an almost similar physical diversity.* The number of species, as seen by the following tables, is for New Mexico more than double that of New England, as would be expected from the known increase of diversity of forms in this country in passing west and south; but the number of generic types is hardly more than half as many more. All the families are represented in each region, and nearly all the American subfamilies, but New Mexico has representatives of Corydinæ (2), Plectopterinae (1), and Myrmecophilinae (2), while New England has none; and New England shows Panchlorinae (2), Perispherinae (1), Pseudophyllinae (1), and Tridactylinae (1), unrepresented in New Mexico; though it should not be overlooked that the only representatives of the two Blattid subfamilies are non-endemic species, and that the other two subfamilies will almost surely be found to occur in New Mexico; the two regions are therefore nearly identical in the subfamilies represented.

The two lists include together 109 genera, of which 87 occur in New Mexico and 54 in New England, 32 being common to both; and 309 species, 230 in New Mexico and 101 in New England, with only 22 species common to both. These 22 species are: *Blattidæ*,—*Ischnoptera uhleriana*, *Blatta germanica*, *Stylopyga orientalis*; *Mantidæ*,—*Stagmomantis carolina*; *Phasmidæ*,—*Diapheromera femorata*; *Acridiidæ*,—*Tettix ornatus*, *Orphulella pelidna*, *Stenobothrus curtippennis*, *Chortophaga viridifasciata*, *Camnula pellucida*, *Dissosteira carolina*, *Spharagemon bolli*, *Schistocera alutacea*, *Melanoplus atlanis*, *M. dawsoni*, *M. femur-rubrum*; *Locustidæ*,—*Scudderia furcata*, *Xiphidium fasciatum*; *Gryllidæ*,—*Gryllus pennsylvanicus*, *G. abbreviatus*, *Ecanthus niveus*, and *E. angustipennis*. It will be at once seen that these are all well-known species of wide range, and in nearly all cases very common wherever they occur.

*The basis of this comparison on the New England side is the list given in *Psyche* (ix., 99-106) with such alterations as have since been recognized. The list contains a number of non-endemic species, but not enough greatly to alter the result.

*Comparative table of New Mexican and New England Orthoptera—
Numbers.*

	GENERA.			SPECIES.		
	N. M.	Common to both.	N. E.	N. M.	Common to both.	N. E.
Forficulidæ.....	2	0	2	2	0	3
Blattidæ.....	7	4	10	9	3	12
Mantidæ.....	3	1	1	4	1	1
Phasmidæ.....	3	1	1	6	1	1
<i>Tettiginæ</i>	2	2	4	6	1	5
<i>Tryxalinæ</i>	21	3	5	37	2	9
<i>Cedipodinæ</i>	19	9	11	61	4	15
<i>Acridiinaæ</i>	12	4	6	65	4	18
Acridiidæ.....	54	18	26	169	11	47
<i>Phaneropterinaæ</i>	5	2	3	9	1	8
<i>Pseudophyllinaæ</i>	0	0	1	0	0	1
<i>Conocephalinaæ</i>	1	1	3	2	1	8
<i>Decticinaæ</i>	3	0	1	5	0	2
<i>Stenopelmatinaæ</i>	3	1	1	11	0	4
Locustidæ.....	12	4	9	27	2	23
Gryllidæ.....	6	4	5	13	4	14
Totals.....	87	32	54	230	22	101

*Comparative Table of New Mexican and New England Orthoptera—
Percentages.*

	GENERA.		SPECIES.	
	N. M.	N. E.	N. M.	N. E.
Forficulidæ.....	2.1	3.7	0.9	3.0
Blattidæ.....	8.0	18.5	3.9	11.9
Mantidæ.....	3.5	1.9	1.7	1.0
Phasmidæ.....	3.5	1.9	2.6	1.0
<i>Tettiginæ</i>	3.7	15.4	3.6	10.6
<i>Tryxalinæ</i>	38.9	19.2	21.9	19.2
<i>Cedipodinæ</i>	35.2	42.3	36.1	31.9
<i>Acridiinaæ</i>	22.2	23.1	38.5	38.3
	100.	100.	100.1	100.
Acridiidæ.....	62.1	48.1	73.5	46.6
<i>Phaneropterinaæ</i>	41.7	33.3	33.3	34.8
<i>Pseudophyllinaæ</i>	0.0	11.1	0.0	4.3
<i>Conocephalinaæ</i>	8.3	33.3	7.4	34.8
<i>Decticinaæ</i>	25.0	11.1	18.5	8.7
<i>Stenopelmatinaæ</i>	25.0	11.1	40.7	17.4
	100.	99.9	99.9	100.
Locustidæ.....	13.8	16.7	11.7	22.8
Gryllidæ.....	6.9	9.3	5.7	13.9
	99.9	100.1	100.	100.2

A comparison of the figures in the two tables shows that of the smaller families — those represented in one or both regions by eleven species or less — the Blattidæ and Gryllidæ are richer (not only relatively but absolutely) in New England than in New Mexico. This poverty of New Mexico is, however, probably due to insufficient collecting, since it is here and in the Locustidæ that the most considerable additions to the New Mexican list are probably to be made. The greatest interest, however, attaches to the two larger families, which have therefore been more fully analyzed. Here the predominance of the Acridiidæ in New Mexico, both relatively and actually, but, of course, especially the latter, is very marked; though it is a very curious fact that, while the subfamily Acridiinae is very highly developed in New Mexico, with double the number of genera and much more than treble the number of species (largely due to its 40 species of *Melanoplus*), its proportion to the numbers of the other subfamilies of Acridiidæ, whether in genera or species, is almost precisely that obtaining in New England. The generic diversity of the New Mexican Tryxalinae is remarkably high, while that of the Tettiginæ is higher in New England than in New Mexico.

As to the Locustidæ, the absence of Pseudophyllinae in New Mexico has been noted as probably due to imperfect knowledge. The most marked feature of the table, surely due to the same cause, is the meagre representation of the Conocephalinae in New Mexico. The preponderance of Stenopelmatinae in New Mexico is marked and due to the large number (8) of species of *Ceuthophilus*.

Finally it may be noted that all the genera containing in either area more than five species are represented in both, as shown in this list.

	N. M.	N. E.
<i>Hippiscus</i>	12	2
<i>Trimerotropis</i>	17	1
<i>Schistocerca</i>	7	3
<i>Melanoplus</i>	40	11
<i>Ceuthophilus</i>	8	4
<i>Æcanthus</i>	4	6

a list which contains more than a fourth of the New England species and more than a third of those of New Mexico, and which shows the prevailing genera of at least the New Mexican fauna. It includes, however, only 6 of the species common to both areas.

FORFICULIDÆ.

Spongophora brunneipennis (Serville).— Taken by Townsend at light at La Cueva, Organ Mountains, c. 5300', September 4.

It is figured in the Biol. centr. amer., pl. 2, figs. 1-3, and in Schultze's Thierreich, xi., figs. 25 a-c.

Apterygida taeniata (Dohrn).— A specimen taken by P. H. Curran at Las Cruces was determined as this species by Burr. It was found on an imported strawberry, and was doubtless brought in from Mexico.

Figured in the Biol. centr. amer., pl. 2, figs. 17-19.

BLATTIDÆ.

BLATTINÆ.

Ischnoptera bolliana Saussure and Zehntner.— Originally described from New Mexico and Texas.

Ischnoptera uhleriana Saussure.— Credited to New Mexico without further specification by Saussure and Zehntner. *Platamodes unicolor* Scudd. and *Ectobia lithophila* Scudd. are synonyms.

It is figured in the Biol. centr. amer., pl. 3, figs. 21-23, and in Lugger's Orth. Minn., fig. 59.

Blatta germanica Linné.— There is no definite reference to this commonest of cockroaches as found in New Mexico, except by Cockerell in Bull. 15 of the N. Mex. agric. coll., who found it in August at Santa Fé. It has never been observed at Las Vegas, where *S. orientalis* is now common.

Good figures will be found in Bull. 4 (n. s.) div. ent. U. S. dep. agric., p. 92.

Temnopteryx texensis Saussure and Zehntner.— Originally described from New Mexico and Texas.

It is figured in the Biol. centr. amer., pl. 3, fig. 31.

NYCTOBORINÆ.

Nyctobora sp.— Las Vegas, in a bunch of bananas (Miss Vashti Thomas); an immature specimen of a species at present indeterminate; bananas at Las Vegas are said to come from Bluefields, Nicaragua, by way of New Orleans.

PERIPLANETINÆ.

Stylopyga orientalis (Linné).— Santa Fé, July 6 (Cockerell); Las Vegas, Aug. 18 (Cockerell); according to Cockerell it "has become

established in Las Cruces, but is by no means universally distributed in New Mexico."

Good figures will be found in Bull. 4 (n. s.) div. ent. U. S. dep. agric., p. 92; and it is also figured in Bull. 35 New Mex. coll. agric.

CORYDINÆ.

Homæogamia bolliana Saussure.—It is credited to New Mexico by Saussure and Zehntner and was taken at light in Las Cruces by Cockerell.

It is figured in the Biol. centr. amer., pl. 5, fig. 3.

Homæogamia subdiaphana Scudder, sp. nov. (pl. 1, fig. 3).—Very pale testaceous, the tegmina as well as the wings subdiaphanous, without mottling or irroration. Head fusco-piceous, the eyes amber-colored, the antennæ fusco-testaceous with pallid incisures. Pronotum elliptico-triangular, strongly arcuate in front, very broadly bent arcuate behind, the front broadly, the lateral margins narrowly luteous, the remainder fusco-castaneous, more or less obscurely dotted mesially with luteous, the extreme posterior margin luteous, the surface, at least in front, most minutely punctate, sparsely pilose. Tegmina ample, apically rounded subacuminate, the marginal field brief (as compared with that of *H. bolliana*), the oblique veins of discoidal field much more longitudinal than in *H. bolliana*, the veins testaceous, those of the anal area somewhat infuscated; wings much as in that species, but shorter. Infragenital plate of male broad, apically broadly, roundly, and considerably emarginate.

Length of body, 10.5 mm.; tegmina, 14.5 mm.; pronotum, 3 mm.; breadth of same, 3.5 mm.

1 ♂. Las Cruces at light, Sept. (Cockerell).

PLECTOPTERINÆ.

Chorisoneura texensis Saussure and Zentner.—Originally described from New Mexico and Texas.

MANTIDÆ.

MANTINÆ.

Litaneutria minor (Scudder).—Specimens have been taken at Aztec, Animas Valley, 4500', July 28-29; Las Vegas Hot Springs (Miss Ada Springer); San Augustine Ranch, Organ Mountains, 5000', Aug. 30 (Wootton in Morse's coll.); and west of La Cueva, Mesilla Valley, Aug. 16 (Cockerell).

Stagmomantis carolina (Linné).—Las Cruces (Cockerell); Mesilla Park, Sept. 20 (Cockerell). Immature specimens belonging either to this or the next species were taken at Mesilla, July 1, by Morse. A very abundant species in the Mesilla Valley; the eggs are parasitised by the chalcidid *Podagrion mantis* Ashm.

Colored figures may be found in the Miss. scient. Mex., vi., pl. 5, fig. 5, pl. 6, fig. 12, and also in Glover's Illustrations, pl. 2.

Stagmomantis limbata (Hahn).—Romerville near Las Vegas, Oct. 1 (W. Wells); La Trementina, Sept. 24, Oct. 7 (Alice Blake); in coitu on *Bigelovia graveolens glabrata*, Oct. 2, at Mescalero by Cockerell; La Cueva, Organ Mountains, c. 5300', Sept. 3 (Townsend); Las Cruces (Cockerell). Both brown and green forms occur.

A colored figure is given in the Miss. scient. Mex., vi., pl. 6, fig. 11.

Oligonyx scudderi Saussure.—La Trementina, Sept. 19 (Miss Alice Blake).

Figured in Glover's Illustrations, pl. 13, fig. 11, pl. 16, fig. 11, and in the Biol. centr. amer., pl. 9, fig. 17.

PHASMIDÆ.

BACUNCULINÆ.

Diapheromera denticrus Stål.—Las Cruces (Cockerell).

A figure (reduced) may be found in Harper's Magazine, lxxxviii., p. 456.

Diapheromera femorata (Say).—Credited to Santa Fé by Halde-man; near Organ Mountains, Mesilla Valley, Aug. (Cockerell).

It has been many times figured, originally by Say in his Amer. ent., pl. 37; see also Rep. U. S. ent., 1878, pl. 3.

Diapheromera velici Walsh.—Albuquerque (Bruner); Pecos River, —N. M., or Tex. (Pope).

Diapheromera mesillana Scudder.—Mesilla, about 2 miles on the road toward Las Cruces, June 30 (Morse).

Bacunculus stramineus Scudder, sp. nov. (pl. 1, fig. 1).—Body very slender, flavo-testaceous, the sides of the thorax, the under surface of the metathorax, and most of the under surface of the middle femora white or hoary, at least in the male, the tibiæ more or less tinged with green in the female; the terminal abdominal segments are more or less hoary (♂) or green (♀). Head a little longer than the pronotum

somewhat tumid in the female, laterally striped with white in the male, in the latter with a pair of longitudinal rugæ following behind the inner margin of the antennal scrobes; antennæ pale green (♀) or testaceous, becoming apically infuscated (♂), very slender and shorter than the body. Body smooth, the thorax with a feeble median carina. Seventh abdominal segment of male nearly as long as the eighth and ninth together, the ninth slightly longer than the eighth, the seventh segment not inflated, bearing beneath a bulbous body not reaching the extremity of the eighth segment with a cap which a little surpasses it; ninth segment cylindrical, equal, truncate, bearing a pair of cerci, —straight, rather stout, but compressed, equal and apically very briefly and bluntly bifid plates, nearly as long as the segment.

Length of body, ♂, 50 mm., ♀, 42 mm.; antennæ, ♂, 22 mm., ♀, 26 mm.; head, ♂, 2.5 mm., ♀, 2.5 mm.; thorax, ♂, 23 mm., ♀, 18.5 mm.; mesothorax, ♂, 12.5 mm., ♀, 9 mm.; abdomen, ♂, 23.5 mm., ♀, 22 mm.; fore femora, ♂, 14 mm., ♀, 10.5 mm.; middle femora, ♂, 11.5 mm., ♀, 8 mm.; hind femora, ♂, 14 mm., ♀, 10.5 mm.; width of metathorax in middle, ♂, 1 mm., ♀, 1.5 mm.

1 ♂, 1 ♀. Between Mesilla Park and Little Mountain, July 1 (A. P. Morse).

The ♀ is probably not quite mature. I have a distinct but allied species from Texas.

BACILLINÆ.

Bacillus coloradus Scudder (pl. 1, fig. 4).—Barker's ranch, Beulah, Sapello Cañon, 8000' on *Monarda stricta* (Willmatte P. Cockerell); La Trementina (Alice Blake). The following description was taken from the first specimen, which is that figured.

Testaceous, more or less clouded with fuscous dorsally. Head striped feebly with fuscous, especially above and with five subequidistant delicate longitudinal carinæ; whole thorax and abdomen similarly carinate, but otherwise smooth except for very minute rather sparsely scattered ferruginous granules between the dorsal and subdorsal carinæ; second joint of antennæ small and globular, the remainder consisting of a hardly articulate, slightly depressed, lanceolate, bluntly pointed mass.

Length of body, 48 mm.; antennæ, 4.5 mm.; mesothorax, 10.5 mm.; metathorax, 8.5 mm.; abdomen, 25 mm.; hind femora, 12 mm.; width of metathorax in middle, 1.5 mm.

ACRIDIIDÆ.

TETTIGINÆ.

Tettix aculeatus (Scudder).—Northern New Mexico, Aug.-Sept. (Carpenter).

Tettix crassus Morse.—In a marshy place at Las Vegas, April 13 (Cockerell). Determined by Morse.

Tettix incurvatus Hancock.—Rio Ruidoso, White Mts., 6500', July 30 (Townsend). Determined by Morse.

Figured by Hancock, Amer. nat., xxix, 761.

Tettix ornatus (Say).—Credited to New Mexico by Bruner and by Haldeman, the latter at Santa Fé. The determination is perhaps uncertain.

Figured originally by Say in his Amer. ent., pl. 5, and since repeatedly; see Morse, Psyche, vii, pl. 6, fig. 2; Hancock, Trans. amer. ent. soc., xxiii, pl. 6, figs. 1, 2, etc.; and Lugger, Orth. Minn., fig. 64.

Paratettix aztecus (Saussure).—Fillmore Cañon, Organ Mts. c. 5700', Sept. 7 (Townsend). Determined by Morse.

Paratettix toltecus (Saussure).—Santa Fé, 7000' (Cockerell); east of Santa Fé, 7475' (Cockerell, no. 4335); Las Vegas Hot Springs, June 21 (Cockerell); Rio Ruidoso, White Mts., 6500', July 30, Sept. 18, 30 (Townsend). Determinations by Morse.

Found in wet grassy places on the borders of streams.

Tettigidea parvifemnis (Harris).—Alkali field, Albuquerque, Dec. 3 (Cockerell). Determined as this species "or very close to it" by Morse.

This species is added after the paper was sent to the printer, and hence is not included in our preliminary remarks.

TRYXALINÆ.

Acantherus (*ἀκανθηρός*) Scudder, gen. nov.

Body rather elongate, compressed. Head shorter than the pronotum, a little protuberant, feebly ascending, broader below than above, apically blunt; vertex nearly plane, the fastigium brief, roundly subtriangular, projecting less than its width beyond the eyes, without distinct median carina; eyes moderate, elongate-elliptical, subvertical, slightly less oblique than the face; frontal costa very narrow, rather prominent, feebly broadening below, straight when viewed obliquely; lateral foveolæ invisible from above, very broad triangular, rather

obscure, the apex of the triangle in the middle above; antennæ half as long as the tegmina, depressed triquetral, at least basally, slender throughout and uniformly tapering. Pronotum rather long, the dorsum nearly plane, the lateral lobes nearly vertical, the median carina distinct but slight, the lateral carinæ forming rounded shoulders, subparallel and not very distant on the prozona, gently divergent on the metazona; prozona distinctly longer than the metazona; lateral lobes a little inflexed above, longer than high, the front and hind margins subparallel in lower half. Prosternum with a transverse quadrangular blunt boss; mesosternal lobes separated by a quadrate space considerably narrower than the lobes themselves, the metasternal lobes by a space half as wide. Tegmina and wings reaching the tip of the abdomen, both slender, the latter unusually so. Hind legs slender, the femora reaching the tip of the abdomen, the tibiæ with about fifteen spines on the outer side.

Only the female has been seen.

Acantherus piperatus Scudder, sp. nov. (Pl. 3, fig. 3).—Dark cinereofuscous, from blackish markings on a testaceous ground. Head reddish testaceous almost wholly overlaid with black longitudinal markings, on the summit broken into points except for a rather broad median stripe; frontal costa as narrow above as the basal joint of the uniformly luteous antennæ, feebly sulcate below. Pronotum testaceous above, reddish testaceous on lateral lobes, heavily sprinkled with black puncta above, wanting on a narrow stripe bordering the lateral carinæ, heavily striped or clouded with blackish on the lateral lobes, especially above, and also punctate, the lateral carinæ faintly divergent in front, the front margin faintly, the hind margin slightly convex. Tegmina flecked with fuscous, pretty uniformly and rather sparsely and slightly infuscated on basal fourth, the anal area subcinereous, flecked with fuscous; wings pellucid, growing gradually infuscated in distal half, the base faintly tinged with greenish. Hind femora dull testaceous, more or less infuscated, especially above, with three broad clouds, the outer two separated by a pregenicular, broad, dull luteous annulus: hind tibiæ with a similar but narrower and clearer postgenicular annulus breaking the black proximal half, the distal half orange red, the spines black except basally.

Length of body, 33 mm.; antennæ, 12.5 mm.; tegmina, 25 mm.; hind femora, 19 mm.; hind tibiæ, 17.5 mm.

2 ♀. La Cueva, Organ Mts., c. 5300', Sept. 3 (Carl H. Townsend).

Mermiria texana Bruner. — Las Vegas Hot Springs, Aug. 10 (Cockerell); Trout Spring, Apr. 27 —immature and doubtful as to species (Cockerell); Mesilla Park, July (Cockerell).

At Las Vegas Hot Springs it is dichroic, green and reddish-brown. The latter is typical, the green form may stand as mut. *civilis* Cockerell.

Figured in Proc. U. S. nat. mus., xii, pl. 1, fig. 11.

Mermiria bicittata (Serville). — Sabinal, Aug. 7, on *Aster spinosus* only (Townsend); Las Cruces, Aug. 10 (Townsend); Mesilla, June 28-30, on bunch grass? (Morse).

Figured in Glover's Illustrations, pl. 6, figs. 24, 26, pl. 11, fig. 7.

Mermiria newmexiana (Thomas). —Originally described from north-eastern New Mexico.

Figured in Glover's Illustrations, pl. 16, fig. 10.

Syrbula acuticornis Bruner. La Trementina, July 15, Aug. 4, Oct. 3, 4, and one immature Oct. 3 (Alice Blake); east of Mesilla Park, July 1 (Morse).

Figured in Proc. Dav. acad., vi, pl. 2, fig. 10.

Syrbula fuscovittata Thomas. Fillmore Cañon, Organ Mts., 5700', Sept. 1 (Townsend).

Figured in Wheeler's Report, v, pl. 45, fig. 7.

Syrbula admirabilis (Uhler). La Trementina, Oct. 3 (Miss Alice Blake).

Figured in Glover's Illustrations, pl. 4, fig. 13.

Acrolophitus hirtipes (Say). Northern New Mexico (Thomas); Pecos River, — N. Mex. or Tex. (Pope).

Figured in Say's Amer. ent., iii, pl. 34; and in Glover's Illustrations, pl. 9, fig. 7.

Beetettix argentatus Bruner. Las Cruces, July 17, "found only on Larrea; its color assimilates well with the peculiar green of the Larrea leaves" (Townsend); on Larrea at Mesilla Park, June 27, July 1, and east toward Little Mt. (Morse).

Figured in Proc. U. S. nat. mus., xii, pl. 1, figs. 4, 5; and in Proc. Dav. acad., vi, pl. 5, fig. 23.

Eritettix navicula (Scudder). Northern New Mexico, Aug., Sept. (Carpenter).

Eupedetes (*ειψ, επιδητης*) Scudder, gen. nov.

Of small size, compact, compressed. Head distinctly shorter than the pronotum, its no way ascending, briefly truncate apically, the face

considerably oblique; vertex with dorsal and approximate subdorsal rather coarse carinations; fastigium extending beyond the eyes as far as its basal breadth, apically rectangular but a little truncate; lateral foveolæ invisible from above, minute, trigonal; frontal costa narrow, plane, subequal, but expanding below the ocellus; eyes parallel to front, subelliptical, moderate; antennæ a little longer than head and prothorax together, filiform, not very slender, scarcely depressed. Pronotum rather short, nearly uniform, the lateral carinæ a very little incurved in the middle, the median carina accompanied by a pair of supplementary median carinæ, the front margin truncate, the hind margin broadly obtusangulate; mesosternal lobes separated by a rather wide space, broader than long. Tegmina and wings slightly surpassing the abdomen and surpassed by the hind femora, which are moderately slender and compressed.

It has much the general aspect of *Amphitornus* but has prominent lateral carinæ on the pronotum and supplementary carinæ on the head; the supplementary carinæ of the pronotum approach the median carina much more nearly than in *Eritettix*, from which it further differs by its non-clavate antennæ.

Eupedetes carinatus Scudder, sp. nov., (pl. 1, fig. 2).—Testaceous, feebly marked with fuscous, beneath flavescent. Head with a broad longitudinal light fuscous stripe behind the upper portion of the eyes, with one or two faint lines behind the eyes below it; antennæ flavo-testaceous; median carina of vertex heaviest in front and especially in the fastigium, which the supplementary carinæ do not enter. Pronotum testaceous, the lateral carinæ marking the outer limit of a light fuscous stripe; supplementary carinæ of pronotum less prominent than the median carina; lateral lobes with a slightly oblique, fuscous-edged, luteous stripe on the lower part of the metazona. Tegmina testaceous flecked with fuscous mesially. Hind femora flavo-testaceous, faintly infuscated above; hind tibiae flavous with 10-11 black spines on either margin.

Length of body, 14.5 mm.; antennæ, 5.5 mm.; pronotum, 3 mm.; tegmina, 10.5 mm.; hind femora, 10 mm.

♂. La Trementina, July 16 (Miss Alice Blake).

Amphitornus ornatus (Scudder).—Little Mt., east of Mesilla Park, July 1 (Morse).

Opeia obscura (Thomas).—La Trementina, Sept. 16, Oct. 4 (Alice Blake); Silver City (Bruner). *Eritettix variabilis* Bruner is a synonym.

Figured in Proc. Dav. acad., vi, pl. 2, fig. 7; and in Glover's Illustrations, pl. 13, fig. 13.

Amblytropidia occidentalis (Saussure).—McNeill says it is found in the Gulf States westward to Colorado and Arizona, and it is therefore entered here, but I have not learned of its capture in New Mexico.

It is figured in Proc. Dav. acad., vi, pl. 3, fig. 13.

Alpha occipitalis (Thomas).—Johnson's Basin, June 22 (Townsend).

Figured in Proc. Dav. acad., vi, pl. 4, fig. 18; and in Glover's Illustrations, pl. 17, fig. 13.

Alpha cinerea (Bruner).—Sand hills near Mesilla, June 27, 30 (Morse). Determination not without doubt.

Alpha crenulata (Bruner).—Silver City (Bruner).

Phlibostroma quadrimaculatum (Thomas).—Plains of northern New Mexico, eastern slope, Oct. 14-31 (Carpenter); Raton, Aug. 27 (Cockerell); La Trementina, Oct. 4 (Miss Alice Blake); Las Vegas, Oct. 13 (Cockerell).

Figured in Proc. Dav. acad., vi, pl. 4, fig. 19; and in Glover's Illustrations, pl. 16, figs. 6, 7.

Orphulella salina Scudder.—Little Round Mt., 9 miles east of Tularosa, 5000', Aug. 24 (Wooton, in Morse's coll.).

Orphulella pelidna (Burmeister).—Albuquerque, on *Helianthus annuus*, Sept. 16 (Cockerell); Mesilla, June 29 (Morse).

Figured in Psyche, vi, 478, figs. 3, 4; and in Lugger's Orth. Minn., fig. 72.

Chlocallis abdominalis (Thomas).—Beulah, Aug. 15 (Cockerell); Aug. 27 (W. P. Cockerell). This species differs from *C. conspersa* by its relatively shorter antennæ, tegmina, and hind legs. It has not before been reported from so far south.

Figured in Glover's Illustrations, pl. 14, fig. 6.

Stenobothrus curtipennis (Harris).—Aqua Fria Park, Colfax Co., 8800', Aug. (E. Atkins); Beulah, on *Solidago*, Aug. 17 (T. D. A. and W. P. Cockerell).

For illustrations, see Psyche, vii., pl. 7, fig. 12; and Lugger's Orth. Minn., figs. 75, 76; also several plates of Glover's Illustrations.

Gomphocerus clavatus Thomas.—Credited to New Mexico by McNeill.

Figured in Glover's Illustrations, pl. 16, fig. 8; and Lugger's Orth. Minn., fig. 76½.

Gomphoceris clepsydra Scudder.—Northern New Mexico, Aug., Sept. (Carpenter). I have not been able to verify this determination by recent examination of specimens; it is possible that they should be referred to *carpenterii* Thom.

The species is figured in Proc. Dav. acad., vi, pl. 6, fig. 27.

Boopedon flavofasciatum Thomas.—Northern New Mexico (Thomas). Figured in Glover's Illustrations, pl. 8, fig. 10.

Boopedon nubilum Say.—Northern New Mexico (Thomas); La Trementina, Oct. 7 (Miss Alice Blake).

Figured in Proc. Dav. acad., vi, pl. 4, fig. 20.

Psoloessa ferruginea Scudder.—La Trementina, July 10 (Miss Alice Blake).

Details are figured in Proc. Dav. acad., vi, pl. 6, figs. 31ab.

Psoloessa maculipennis Scudder.—Johnson's Basin, June 22 (Townsend).

Figured in Proc. Dav. acad., vi, pl. 6, fig. 31.

Psoloessa texana Scudder.—This species also has never been reported from New Mexico, but is known both from Texas and California and probably occurs in New Mexico.

Details are figured in Proc. Dav. acad., vi, pl. 6, fig. 30c.

Stirapleura ornata (Scudder).—Northern New Mexico, Aug., Sept. (Carpenter); Organ Mts., Aug. 30 (Townsend).

Stirapleura decussata Scudder.—La Trementina, July 10, Aug. 3 (Alice Blake); Las Vegas, April 8; the first winged grasshopper of the season, in 1901, and very common by April 12 (Cockerell). It occurs on open ground, especially where it is dry.

Figured in Proc. Dav. acad., i, pl. 36, figs. 3, 4; vi, pl. 6, fig. 30.

Stirapleura pusilla Scudder.—La Cueva, Organ Mts., c. 5300', Aug. 31 (Townsend); Mesilla Park, May 22, July 21 (Cockerell); on mesa at Mesilla Park and east toward Little Mt., July 1 (Morse).

Ageneotettix deorum Scudder.—Mesilla Park, July 2 (Morse).

Figured in Proc. Dav. acad., vi, pl. 6, fig. 29.

Ageneotettix scudderi (Bruner).—Chaves, Aug. 6 (Townsend).

Figured in Lugger's Orth. Minn., fig. 77.

Ageneotettix sp.—Beulah, Aug. 18 (Cockerell). An apparently new species, of which I await more specimens before describing. It has slenderer hind legs than the known species and more prominent pronotal carinae.

Aulocara rufum Scudder.—La Cueva, Organ Mts., c. 5300', Sept. 3 (Carl H. Townsend).

Aulocara elliotti (Thomas).—Johnson's Basin, June 22. "Very abundant in the short native grass. It occurred in large numbers and caused considerable injury to the grass" (Townsend). The next day it occurred in valleys on the Springfield Road near the Arizona line; grain fields and alfalfa were almost wholly destroyed repeatedly from 1889 to 1891, probably by this insect, according to Townsend.

Figured in Glover's Illustrations, pl. 8, fig. 11.

(EDIPODINÆ.

Arphia tenebrosa (Scudder).—Credited to New Mexico by Thomas and Saussure. Taken at Las Cruces in Sept., by Townsend.

Figured in Glover's Illustrations, pl. 9, fig. 2, and in Lugger's Orth. Minn., figs. 81, 82.

Arphia nictana (Saussure).—Raton, Aug. 27 (Cockerell); mouth of Sapello Cañon, Sept. 7 (Cockerell); La Trementina, Oct. 3, 4 (Miss Alice Blake); Las Vegas, Oct. 26 (Cockerell); Rio Ruidoso, c. 6500', Aug. 9 (Townsend); Ruidoso Creek, White Mts., 2 miles west of Dooling's Mill, c. 6500', Aug. 20 (Wooton, in Morse's coll.); Gilmore's Ranch, Eagle Creek, White Mts., 7000', Aug. 10-16 (Wooton, in Morse's coll.); Pecos River,—Tex. or N. Mex. (Pope); Mesilla Park, Oct. 21 (Cockerell).

Not before recorded from the United States. I have also seen specimens from Colorado, 5500', (Morrison); Pueblo and Manitou, Col. (Scudder); Ft. Collins, Col. (Baker); and Utah—American Fk. Cañon, 9000', Provo, and Salt Lake Valley (Scudder). I formerly thought the species undescribed and distributed some specimens under the MS. name *insignis*.

Arphia arcta Scudder.—Trout Spring, April 27 (Martin Cockerell).

Arphia teperata Scudder.—Northern New Mexico, Aug., Sept. (Carpenter); Las Vegas, April 12, "its first appearance in 1901" (Cockerell); Las Cruces, May 9, in alfalfa fields, Sept. (Townsend); Little Mt., Mesilla Park, July 1 (Morse). They make a rattling or crackling noise as they fly; the color of the thorax, tegmina, etc., exactly matches the soil of this vicinity—Las Vegas—so that when they settle in a rut in the road they seem quite to disappear (Cockerell).

Chortophaga viridifasciata (De Geer).—Northern New Mexico, Aug., Sept. (Carpenter); Las Vegas, April 13, in a marshy alkaline

grassy spot, where the grass is white with a saline deposit (Cockerell); Mesilla (Cockerell, in Morse's coll.).

A colored figure will be found in the 1862 edition of Harris's *Ins. inj. veg.*, pl. 3, fig. 2; and details are shown in *Psyche*, vii, pl. 2, fig. 18, and Saussure's *Prodr. Oed.*, pl., figs. 7, 12.

Encoptolophus costalis (Scudder).—Given doubtfully by Townsend (*Ins. life*, vi, 31) as from Las Cruces, May 8-12, in alfalfa. Probably the next species.

Encoptolophus parvus Scudder.—Near Las Vegas, in stomach of herring gull, the species somewhat doubtful (Cockerell); Las Vegas, Oct. 3 (John McNary), Oct. 5 (Cockerell); White Mts., Aug. 9 (Townsend); Gilmore's Ranch, Eagle Creek, White Mts., 7000', Aug. 10-16 (Wooton, in Morse's Coll.); Mescalero Reservation, Oct. (Cockerell); Las Cruces, July 8 (Cockerell, Townsend); Mesilla, in alfalfa field, June 27-30 (Morse); Mesilla, Oct. 24, 18 (Cockerell, in Morse's coll.).

Cammula pellucida (Scudder).—Aqua Fria Park, Colfax Co., 8800', Aug. (E. Atkins); ridge between Sapello and upper Pecos River, c. 11,000', Aug. (Cockerell); Beulah, July 25, Aug. 13 (Cockerell); Mountains above Beulah, Aug. 9 (Cockerell); La Trementina, Aug. 3 (Alice Blake); Johnson's Basin, June 22 (Townsend); Valencia Co., at continental divide, Aug. 2 (Townsend).

For figures see Glover's Illustrations, pl. 12, fig. 20; Luggers's *Orth. Minn.*, figs. 87, 88; Report U. S. ent. comm., ii, fig. 10; and for details, *Psyche*, viii, pl. 2, fig. 20.

Hippiscus pantherinus Scudder.—Five miles east of Tularosa, July 3 (Wooton, in Morse's coll.); Mesilla, sand hills (Morse).

Hippiscus haldemanni (Scudder).—Credited to New Mexico by Thomas, but perhaps by mistake for another species.

Figured in Glover's Illustrations, pl. 18, fig. 14.

Hippiscus saussurei Scudder.—Credited to New Mexico by Thomas, but perhaps by mistake for another species.

Hippiscus corallipes (Haldeman).—Each side of the Raton Mts. (Thomas); La Trementina, July 6, 10, 16, 18, Sept. 20 (Alice Blake); Albuquerque (Bruner); Las Cruces (Townsend); Silver City (Bruner).

Figured in Stansbury's *Utah*, pl. 10, fig. 2.

Hippiscus zapotecus (Saussure).—Taos and Albuquerque (Bruner); Johnson's Basin, June 23 (Townsend); Jornada del Muerto, north of Las Cruces (Townsend); Silver City (Bruner).

Hippiscus conspicuus Scudder.—Silver City (Bruner).

Hippiscus pardalinus (Saussure).—Las Vegas, April 23, very abundant in open grassy places (Cockerell); credited to New Mexico by Saussure. It is remarkable that this species, so abundant at Las Vegas, should not have been seen elsewhere.

Hippiscus leprosus (Saussure).—Credited to New Mexico by Saussure.

Hippiscus paradoxus (Thomas).—Taos Valley, May 30 (Bruner); Las Vegas, July 4 (Louisa Reed).

Hippiscus pumilus Scudder.—Taos Valley (Bruner).

Hippiscus neglectus (Thomas).—Northeastern New Mexico (Thomas). Figured in Rep. Wheeler's Survey, v, pl. 44, fig. 3; and Proc. Dav. acad., i, pl. 36, fig. 6.

Hippiscus montanus (Thomas).—Taos Valley (Bruner).

Figured in Glover's Illustrations, pl. 12, fig. 12.

Leprus wheeleri (Thomas).—Credited to New Mexico by Saussure; Raton, Sept. (W. P. Cockerell); La Cueva, Organ Mts., c. 5300', Aug. 30 (Townsend); Dripping Springs, Organ Mts. (Cockerell); Grant Co. (W. J. Howard, fide Townsend). It frequents rocky places, and when at rest accords remarkably well in color and markings with the surroundings.

Figured in Rep. Wheeler's Survey, v, pl. 44, fig. 1.

Tropidolophus formosus (Say).—Raton, Sept. (W. P. Cockerell); Pecos River—Tex. or N. Mex. (Pope); Grant Co. (W. J. Howard, fide Townsend); Mesilla Park, July 1, Sept. 21, Oct. 21 (Morse, Cockerell); Mesilla, Oct. 14 (Cockerell). In the Mesilla Valley it was found to occur on the sand hills, in the *Pluchea* region.

Figured in Say's Amer. ent., iii, pl. 34; in Glover's Illustrations, pl. 9, fig. 5; and in Thomas's Syn. Acrid., pl., fig. 1.

Mimastus carolina (Linné).—Credited to New Mexico by Thomas and Scudder; Raton, Sept. (W. P. Cockerell); Gallup, Sept. 16, 17 (Larkin); Las Vegas Hot Springs, Sept. 12 (Cockerell); La Trementina, July 10 (Alice Blake); Santa Fé (Cockerell); Las Vegas, Oct. 13 (Cockerell); South Fork of Eagle Creek, White Mts., c. 8000', Aug. 13 (Townsend); Rio Ruidoso, White Mts., c. 6500', July 19, Aug. 9 (Townsend); Mescalero agency, 6300', July 27 (Wootton, in Morse's coll.); Grant Co. (W. J. Howard, fide Townsend). Very abundant where it occurs. In flight it has a curiously close resem-

blance to *Euvanesa antiopa*. At rest, its colors accord so closely with the soil that it becomes almost invisible.

Often figured; among others, see Harris's *Ins. inj. veg.*, ed. 1862, pl. 3, fig. 3; Glover's *Illustrations*, pl. 5, fig. 3; and Lugger's *Orth. Minn.*, fig. 95.

Dissosteira longipennis (Thomas).—Plains of northern New Mexico, eastern slope, Oct. 13 (Carpenter); northeastern New Mexico (Bruner): La Trementina, July 12 (Alice Blake); Las Vegas, Oct. 13 (Cockerell); Rio Ruidoso, White Mts., July 30 (Townsend). Last year (1900) this insect invaded the town of Las Vegas in great numbers, and crushed specimens were everywhere seen on the sidewalks.

Figured in Glover's *Illustrations*, pl. 13, fig. 4; and in *Bull. 28 div. ent. U. S. dep. agric.*, figs. 19, 20

Spharagemon bolli Scudder.—Las Vegas Hot Springs, Sept. 12 (Cockerell); Chaves, Aug. 6 — the species queried (Townsend); Rio Ruidoso, White Mts., c. 6500', Aug. 9 (Townsend).

Figured in Lugger's *Orth. Minn.*, fig. 98; the details in *Psyche*, viii, pl. 2, fig. 26.

Spharagemon cristatum Scudder.—La Trementina, Aug. 3 (Alice Blake); Mesilla, in alfalfa field, June 29 (Morse).

Spharagemon inornatum Morse.—Hot Springs, 7000' (Bruner t. Morse).

This species (and indeed all the others mentioned in the paper in which it was described, *Psyche*, vii, 287-299) was carelessly omitted from my *Index to described Orthoptera*.

Lactista pellepidus Saussure (pl. 3, fig. 1).—Organ Mts., Aug. 30 (Townsend); Organ Mts., 5100', Sept. 28 (Cockerell); Fillmore Cañon, Organ Mts., c. 5700', Sept. 1 (Townsend).

New to the United States; the specimens do not completely agree with Saussure's description and may be distinct and in that case undescribed.

The generic name should perhaps be changed. Schödté gave the name *Lactistes* to a genus of Hemiptera in 1848.

Derotmema laticinctum Scudder.—La Cueva, Organ Mts., c. 5300', Aug. 31 (Townsend); Las Cruces (Cockerell, Townsend); Mesa east of Las Cruces, c. 4000', Sept. 10 (Carl H. Townsend); Mesilla, in river bed and on sand hills, June 30 (Morse); Mesilla Park, on mesa, June 30 (Morse). It especially frequents open ground.

Derotmema cupidinum Scudder.—Northern New Mexico, Aug., Sept. (Carpenter).

Derotmema haydeni (Thomas).—Raton, Aug. 27 (Cockerell); Raton, Sept. (W. P. Cockerell); Rociada, Aug. 20 (Cockerell); Las Vegas, Aug. 8, Oct. 5 (Cockerell); Oct. 4 (John McNary); South fork of Eagle Creek, White Mts., c. 8000', Aug. 19 (Townsend); Mesilla Park, common (Cockerell).

As is well known, there are two forms, one with red, the other with yellow wings; the former seems to be much the more common in New Mexico, as everywhere, and may be regarded as the type; the yellow winged form may bear the varietal name *flavum* Scudder.

Figured in Glover's Illustrations, pl. 15, fig. 4.

Mestobregma asperum (Scudder).—Plains of northern New Mexico, eastern slope, Oct. 14-31 (Carpenter); Raton, Aug. 27 (Cockerell); Las Vegas, Oct. 26 (Cockerell); Las Vegas Hot Springs, Sept. 12 (Cockerell); La Trementina, Oct. 3 (Miss Alice Blake); Gilmore's Ranch, Eagle Creek, White Mts., 7000', Aug. 10-16 (Wooton, in Morse's coll.); two miles west of Dooling's Mill, Ruidoso Creek, White Mts., 6500', Aug. 20 (Wooton, in Morse's coll.); Mescalero Reservation, Oct. 3 (Cockerell); Silver City (Bruner). *Psinidia* (*Trachyrachis*) *mexicana* Sauss. is probably a synonym.

Mestobregma coronatum (Scudder).—Northern New Mexico, Aug., Sept. (Carpenter).

Conozoa acuminata Scudder, sp. nov. (Pl. 2, fig. 4).—Ferrugineo-fuscous. Head more or less infuscated above, the vertex but little elevated, well rounded and feebly corrugated transversely, the fastigium rather deeply sulcate with parallel sides, converging on anterior half, nearly twice as long as broad, posteriorly with a slight median carina; frontal costa sulcate, narrow, subequal; lateral foveolæ minute, trigonal; antennæ (♂) shorter than hind femora, fuscous with broad pallid annulations. Pronotum nearly uniform ferrugineo-fuscous with only faint cloudy markings, the disk nearly plane and exceptionally smooth, having only slight obscure granulations, the median carina slight and nearly uniform throughout, though really more prominent on the prozona, but at the same level seen laterally, the lateral carinae forming sharp shoulders, the posterior process faintly obtusangulate, the lower margin of the lateral lobes furnished posteriorly with a depending, slightly produced, rectangulate dentation. Tegmina griseous, broadly infuscated along costal margin, but twice interrupted with cinerous

after the fashion of *Conozoa*, the middle field mostly pellucid in distal half; wings with the proximal half pale citron, beyond mottled, fusco-infumate, with a subcostal taenia running half way to the base and a large semi-pellucid subapical area. Hind femora fusco-testaceous, twice obliquely fasciate with fuscous in the middle area; hind tibiae red, pale luteous basally.

Length of body, 17 mm.; antennae, 9 mm.; tegmina, 19.5 mm.; hind femora, 10 mm.

1 ♂. Mesilla, June 27, A. P. Morse.

Conozoa corrugata Scudder, sp. nov.—Dark ferrugineo-testaceous. Head impure testaceous, more or less infuscated above and with small fuscous blotches; vertex well elevated, strongly rounded, laterally transversely corrugate; fastigium subpyriform with elevated margins, but little longer than broad, open to the deeply sulcate frontal costa, which is narrow, particularly between the antennae, but distinctly enlarged at the ocellus; lateral foveolae very distinct with high walls but open behind, trigonal, a trifle elongate; antennae (♂) much shorter than the hind femora, ferruginous, apically infusate and in the middle half annulate with fuscous. Pronotum short, mesially constricted, almost uniformly ferrugineo-testaceous, the disk rather heavily corrugate, with a distinct small scutellum on the posterior half of the prozona, the median carina subequal, a little elevated, the lateral carinae rather obscure, rounded, the posterior process rectangulate, the inferior margin of the lateral lobes a little oblique and terminating posteriorly in a subacutangulate process. Tegmina rather broader than usual in the genus, the basal portion of the costal half with two conspicuous blackish fuscous patches, each followed distally by a pallid cinereous patch, the rest of the tegmina flecked rather minutely with fuscous but beyond the outer cinereous patch mostly subpellucid; wings pale citron in the proximal half, followed by a blackish fuscous band about as broad as the metazona, but narrower in the middle, and in the costal area sending a rather short taenia baseward; beyond, the wing is pellucid, though the costal margin is blackish fuscous and the veins in the apical area are often blotched with fuscous. Hind femora brownish testaceous, obscurely clouded with fuscous, with a pregenicular pallid annulus, most distinct on inner side; hind tibiae very pale obscure glaucous, infuscated basally, and a little apically, the spines black-tipped.

Length of body, 29 mm.; antennae, c. 10.5 mm.; tegmina, 26 mm.; hind femora, 14 mm.

1 ♀. Fillmore Cañon, Organ Mts., Aug. 27 (Cockerell).

Conozoa melleola Scudder, sp. nov. (Pl. 2, fig. 2).—Cinereo-testaceous, marked with fuscous. Head with all below a line from lower margin of eyes to base of frontal costa pale clear luteous, above it dull testaceous with a fuscous stripe behind the eyes heavily margined above with luteous; vertex well elevated, smooth, with a transverse sulcus between the eyes, the fastigium in front of it nearly twice as long as broad with sharp and rather high walls, parallel behind, converging in front and continuous with the margins of the narrow, deeply sulcate frontal costa, which gradually broadens below the ocellus; lateral foveolæ small, distinct, trigonal; antennæ a little shorter than the hind femora, pale testaceous and fusco-annulate in basal third or more, becoming wholly dark fuscous beyond. Pronotum very short and strongly constricted mesially, luteous but heavily marked with ferrugineo-fuscous in a quadrate patch in the middle of the lateral lobes in front, and a stripe following the postocular stripe of the head, broken by a narrow luteous stripe following the course of the lateral carinæ, besides which most of the disk of the metazona is dark; the disk is nearly smooth, but there is a distinct small scutellum on the posterior half of the prozona; the median carina is elevated on the front half of the prozona, nearly obliterated between the sulci (in the scutellum) and feeble on the metazona; lateral carinæ marked in color and hardly otherwise; lower margin of lateral lobes oblique, meeting the posterior margin in a slightly acute, rounded angle. Tegmina testaceous in basal half, pellucid in apical half, with two rather heavy fuscous patches nearly crossing the tegmina in basal half, and two or three similar but exceedingly faint patches in apical half; wings bright citron in basal half, followed by a very unequal curving fuscous band, at its broadest equalling the length of the pronotum, beyond which the wings are pellucid but for the infuscation of the veins and of the costal margin and sometimes a few apical fuscous flecks. Hind femora cinereo-testaceous with an oblique mesial fuscous stripe; hind tibiæ luteous with black-tipped spines.

Length of body, 16.5 mm.; antennæ, 10.5 mm.; tegmina, 19 mm.; hind femora, 12 mm.

2 ♂. La Cueva, Organ Mts., c. 5300', Sept. 23 (Townsend). Subsequently sent from La Trementina, Aug. 3, by Miss Alice Blake.

Conozoa picturata Scudder, sp. nov.—Fuscous, marked with pale cinereous. Head colored much as in *C. melleola*, but darker above behind the fastigium; vertex well elevated, somewhat corrugated transversely behind; fastigium not much longer than broad with elevated

walls which converge abruptly in front but leave the fastigium open to the irregularly sulcate frontal costa, which is narrow, contracted just above the ocellus and hardly widens below; lateral foveolæ moderate, distinct, trigonal; antennæ (♂) slightly longer than the hind femora, pale testaceous in proximal third, dark fuscous beyond. Pronotum rather short, somewhat constricted mesially, variable in color, at extreme dark fuscous, with the lower half of the lateral lobes, the lateral carinae in a broad band broadening anteriorly, and the margin of the posterior process clay brown, the disk lightly corrugate and equally on prozona and metazona, the prozona with a slight scutellum posteriorly; median carina rather high, subequal, the pronotal portion independently rounded above; lateral carinae present only as rounded shoulders on the metazona: lateral lobes with a rounded angulation behind, the lower margin sinuous. Tegmina fuscous in basal half with two large blackish fuscous patches anteriorly, each followed by a cinereous patch, the outer half or less pellucid, heavily flecked anteriorly with fuscous; wings citron in basal half, followed by an arcuate fuscous band, at its narrowest as broad as the metazona, more or less mottled in anterior half, sending a humeral tænia nearly half way to the base, beyond pellucid with fuscous veins, the extreme tip and costal margin fuscous. Hind femora fuscous on inner side with pregenicular pallid annulus, pale cinereo testaceous outside, bifasciate obliquely with fuscous especially above; hind tibiae pale glaucous with a fuscous base and faint pale postgenicular annulus, the spines black-tipped, the tarsi testaceous.

Length of body, 18.5 mm.; antennæ, 13 mm.; tegmina, 23 mm.; hind femora, 12 mm.

2 ♂. Fillmore Cañon, Organ Mts., c. 5700', Sept. 1 (Townsend); La Cueva, Organ Mts., c. 5300', Sept. 3 (Townsend).

Trimerotropis texana (Bruner).—Las Cruces, May 19, Sept. 2, rather common (Townsend); Las Cruces, July 8 (Cockerell); Mesa east of Las Cruces, c. 4000', Sept. 10 (Townsend); Mesilla and Mesilla Park, June 27, 30 (Morse); Mesilla Park, July 17 (Cockerell).

Trimerotropis cincta (Thomas).—Originally described by Thomas from New Mexico only; no others have been quoted from any particular part of the Territory.

Figured in Glover's Illustrations, pl. 12, fig. 13.

Trimerotropis juliana Scudder.—Santa Fé, July (Cockerell).

Trimerotropis cæruleipes Scudder.—Las Vegas Hot Springs, Sept. 12 (Cockerell). A single specimen appears to belong to this Pacific

coast species, although the transverse fuscous band is exceptionally deep in color.

Trimerotropis tessellata McNeill.—Rio Ruidoso, White Mts., c. 6700', July 29; c. 6500', Aug. 1 (Townsend).

Trimerotropis cyanea Scudder, sp. nov. (Pl. 2, fig. 3).—Griseous, flecked with fuscous. Head plumbeo-testaceous, heavily flecked with fuscous, above much infuscated; vertex nearly smooth, the fastigium nearly twice as long as broad, with or without a slight median carina; frontal costa narrow, subequal, punctate and plane above, at and below the ocellus sulcate with heavy margins; antennæ (♂) slightly shorter than hind femora, fuscous, annulate with dull ferruginous. Pronotum normal, the metazona not greatly expanded, the disk delicately granulate, the process rectangulate, the median carina moderate and nearly uniform, highest on the anterior lobe of the prozona, and on each lobe independently rounded, the lateral carinae rather pronounced throughout, the lower posterior angle of the lateral lobes well rounded. Tegmina rather broad, the space between the ulnar forks rather narrow but with two rows of cells, the whole dark testaceous, heavily flecked with fuscous, except just beyond median and pre-median fuscous patches, crossing or almost crossing the tegmina; wings moderately broad, blue on the basal half, sometimes tinged with green, followed by a broad arcuate fuscous band, half as broad in the middle as where it first strikes the margin, which it follows half way to the anal angle; a stout tænia is emitted in the humeral area, running half way to the base; the costal area beyond is fuscous to the apex, which also is heavily infuscated and the hyaline area before it is sometimes reduced to slight dimensions, but is usually nearly as broad as the median band and is crossed by fuscous veins. Hind femora brownish testaceous, normally twice feebly fasciate with fuscous, the inner surface black, twice crossed in apical half by light bands; hind tibiae bright blue with an obscure postgenicular pallid annulus following a fuscous base; tarsi pallid.

Length of body, 22 mm.; antennæ, 11 mm.; tegmina, 24 mm.; hind femora, 12 mm.

3 ♂. South fork of Eagle Creek, White Mts., c. 8000' (Townsend); Dripping Spring, Organ Mts. (Cockerell); Fillmore Cañon, Organ Mts., c. 5700' (Townsend). In the Organ Mts. it occurs in company with *Leprus wheeleri*, which also has blue wings.

Trimerotropis monticola Saussure.—Credited to New Mexico by Saussure.

Trimerotropis bruneri McNeill.—La Cueva, Organ Mts., c. 5300', Aug. 30 (Townsend). *Hadrotettix gracilis* Bruner is a synonym.

Trimerotropis fascicula McNeill.—Silver City (Bruner, t. McNeill).

Trimerotropis alliciens Scudder, sp. nov. (Pl. 2, fig. 1).—Arenaceous, marked with dull fuscous. Head more or less hoary excepting above; vertex smooth with a faint median carina which extends through the fastigium and is sometimes confined to it, the latter hardly half as long again as broad; frontal costa narrow, contracted at apex and below the ocellus, sulcate throughout excepting at apex; antennæ (♂) as long as the hind femora, fusco-ferruginous, lighter at base. Pronotum with a slight ferruginous tinge, nearly uniform in color, but somewhat hoary on the lateral lobes, the metazona somewhat expanded and slightly tumid, the disk delicately rugulose and punctate, the process rectangulate or faintly obtusangulate, its tip rounded; median carina moderate and roundly bilobed on the prozona, slight on the metazona; lateral carinae pronounced throughout, the lower margin with an obtusangulate tooth posteriorly. Tegmina moderately broad, the space between the ulnar forks moderately broad with two or more rows of cells, the proximal two-thirds or less arenaceous but infuscated at base, crossed by three subequidistant fuscous patches, the outer and sometimes the central more or less broken, the distal third hyaline flecked feebly with fuscous; wings moderately broad, citron on basal half, crossed beyond by an arcuate fuscous band broader than the metazona, with a coarse humeral tænia running a third of the way to the base, the costal margin beyond its summit bluish fuliginous, the apex hyaline with fuscous veins and sometimes a slight fuscous patch. Hind femora cinereous or cinereo-testaceous twice more or less distinctly banded with fuscous, within black crossed beyond the middle by two flavous bands; hind tibiæ red.

Length of body, 25 mm.; antennæ, 12 mm.; tegmina, 26 mm.; hind femora, 12 mm.

2 ♂. La Cueva, Organ Mts., c. 5300', Aug. 31 (Townsend).

Trimerotropis modesta Bruner.—Little Round Mt., 9 miles east of Tularosa, 5000', Aug. 24 (Wooton, in Morse's coll.); Silver City (Bruner).

Trimerotropis citrina Scudder.—Tularosa (Cockerell); Las Cruces (Cockerell); Mesilla, in river bed, June 27, 28 (Morse).

Trimerotropis laticincta Saussure.—Credited to New Mexico by McNeill; Las Vegas, Oct. 3 (M. D. Cockerell); South fork of Eagle

Creek, White Mts., c. 8000' (Townsend); Mescalero Reservation, Oct. 3 (Cockerell); Silver City (Bruner).

Mr. Cockerell took a pair in coitu at East Las Vegas, Oct. 19, and noted the following sexual differences:—

Male: Hind femora with only one light band on inner face; black band of wings very large, its inner edge straight or nearly so.

Female: Hind femora with two light bands on inner face; black band of wings not so broad, its inner edge strongly concave.

The species seems more particularly to affect the ranker vegetation in (not always) relatively low spots.

Trimerotropis melanoptera McNeill.—Silver City (Bruner, t. McNeill.)

Trimerotropis vinculata Scudder.—Credited to New Mexico by Bruner; Raton, Aug. 27 (Cockerell); Gallup, Sept. 16, 17 (R. R. Larkin); Santa Fé, 7000' (Cockerell); Las Vegas, Oct. 13, 26 (Cockerell); La Trementina, July 10, Aug. 3, Sept. 16, Oct. 3 (Alice Blake); Mescalero Reservation (Cockerell); Northern end of Organ Mts., in coitu, Nov. 26 (Townsend); La Cueva, Organ Mts., c. 3000', Aug. 10 (Townsend); Las Cruces (Townsend); Mesilla, in river bed, and Mesilla Park, June 27, 30, July 1 (Morse); Silver City (Bruner).

This species is found where (as compared with the haunts of *T. laticincta*) the land is higher and dryer, and the vegetation more scanty.

Figured in Rep. U. S. ent. comm., ii, pl. 17, fig. 11.

Trimerotropis obscura Scudder.—Northern New Mexico, Aug., Sept. (Carpenter). *Trim. fallax* Sauss. is a synonym of this.

Trimerotropis nubila McNeill.—Hot Springs, 7000' (Bruner, t. McNeill); Rio Ruidoso, White Mts., c. 6500', Aug. 30 (Townsend).

Circotettix sparsus (Thomas).—Originally described from New Mexico. Not since recognized.

Figured in Rep. Wheeler's Surv., v, pl. 45, fig. 6.

Circotettix undulatus (Thomas).—Aqua Fria Park, Colfax Co., 8800', Aug. (E. Atkins); top of range between Sapello and upper Pecos River, 11,000' (Cockerell); Dailey Cañon, c. 8100', Aug. 10 (Cockerell); South fork of Eagle Creek, White Mts., c. 8000', Aug. 10 (Townsend).

Figured in Glover's Illustrations, pl. 12, fig. 15; the wing in Sausure's Add. prodr. Oed., pl., fig. 6.

Hadrotettix trifasciatus (Say).—Credited to New Mexico by Thomas and Saussure; Northern New Mexico (Carpenter).

Figured in Say's Amer. ent., iii, pl. 34; and in Glover's Illustrations, pl. 9, fig. 6.

Heliastus aridus (Bruner).—Albuquerque (Bruner): Las Cruces, May 18 (Townsend); Mesa east of Las Cruces, c. 4000', Sept. 10 (Townsend); Mesilla, on sand hills, and Mesilla Park on gravelly mesas, June 27, July 1 (Morse).

Figured in Proc. U. S. nat. mus., xii, pl. 1, figs. 2, 3.

Brachystola magna (Girard).—Northern New Mexico, Aug., Sept. (Carpenter); Plains of northern New Mexico, eastern slope, Oct. 14-31 (Carpenter); Santa Fé (Thomas); Ruidoso Creek, White Mts., near Dooling's Mill, Aug. 20 (Wooton, in Morse's coll.); Rio Ruidoso, White Mts., c. 6800', Aug. 5 (A. C. Tyson); San Augustin ranch, Organ Mts., 5000', Aug. 30 (Wooton, in Morse's coll.); West side of Organ Mts.—Riley's ranch or La Cueva—5000'. Sept. 4 (Wooton, in Morse's coll.). Mrs. Cockerell found it common at Raton. It frequents open, rocky ground.

For figures, see Marcy's Red River, pl. 15, figs. 1-4; Glover's Illustrations, pl. 7, fig. 11; Rep. U. S. ent. comm., i, fig. 8; and Standard nat. hist., ii, fig. 270.

Brachystola virescens (Charpentier).—Credited to New Mexico by Bruner.

Figured by Charpentier in his Orth. descr., pl. 51: and in Glover's Illustrations, pl. 9, fig. 3.

Haldemanella verruculata (Uhler).—La Cueva, Organ Mts., c. 5300', Aug. 31 (Townsend); Las Cruces (Townsend); Pecos River,—Tex. or New Mex. (Pope).

Figured in Glover's Illustrations, pl. 6, fig. 25.

ACRIDINÆ.

Tæniopoda pecticornis Stal.—Grant Co. (W. J. Howard, fide Townsend).

Paropomala virgata Scudder.—Mesilla on bunch grass, on road toward Las Cruces and at sand hills, June 29 (Morse).

Clematodes larreae Scudder.—On Larrea at Mesilla Park, May 22 (Cockerell).

Schistocerca zapoteca Scudder.—Las Vegas (Cockerell). New to the United States.

Schistocerca vaga (Scudder).—Mesilla, Oct. 18 (Cockerell).

Schistocerca alutacea (Harris).—Las Cruces, Aug. 19 (Townsend); Mesilla, on road toward Las Cruces, June 30 (Morse).

Often figured; see among others Glover's Illustrations, pl. 8, fig. 13, pl. 10, fig. 13; and Lugger's Orth. Minn., fig. 104; and for details, Psyche, viii, pl. 7, fig. 32.

Schistocerca obscura (Fabricius).—White Sands, 30 miles south of Tularosa, 3600', Aug. 25 (Wooton, in Morse's coll.); La Cueva, Organ Mts., c. 5300', in coitu Sept. 3 (Townsend).

Figured in Glover's Illustrations, pl. 5, fig. 12; and in Ent. news, iv, 48, fig. b.

Schistocerca albolincata (Thomas).—Las Cruces, Aug. 19 (Bruner); Mesilla, on road toward Las Cruces, June 30 (Morse).

Figured in Rep. Wheeler's Surv., v, pl. 43, fig. 1.

Schistocerca venusta Scudder.—It has never been reported from New Mexico, but is sure to occur there as it has been found in Texas, Arizona, and Utah.

Shistocerca shoshone (Thomas).—Pecos River—Tex. or N. Mex. (Pope); Chaves, Aug. 6 (Townsend): Las Cruces, on mesquite, which it often defoliates, early in July, Oct. 24 (Townsend); Las Cruces (Cockerell); Mesilla, on road toward Las Cruces, June 30 (Morse); Mesilla, July 4 (Cockerell).

Figured in Glover's Illustrations, pl. 15, fig. 3; and in Rep. Wheeler's Surv., v, pl. 43, fig. 2.

Conalcaea neomexicana Scudder.—Silver City (Bruner).

Genitalia figured in Scudder's Rev. Mel., pl. 2, fig. 9.

Campylacantha vivax (Scudder).—Plains of northern New Mexico, eastern slope, Oct. 14-31 (Carpenter); La Trementina, Oct. 4 (Miss Alice Blake).

Genitalia figured in Scudder's Rev. Mel., pl. 4, fig. 6.

Campylacantha vegana Scudder and Cockerell, sp. nov.—Allied to *C. vivax* Scudd., from which it differs as follows:

<i>vegana.</i>	<i>vivax.</i>
<i>Color:</i> Lively sea green, the light markings pure white.	yellowish green with brownish markings, the stripes of pronotum yellowish.
<i>Longitudinal stripe on top of head</i> dark green, bordered broadly on each side with greenish yellow.	brown.

<i>Antennæ</i> light vermillion, the first two joints white.	light brown.
<i>Pronotum</i> as broad as head.	narrowed behind head.
<i>Tegmina</i> very obtuse, broad.	lanceolate.
<i>Hind femora</i> green, vittulate with white, and with a white stripe on lower outer margin, above which is a yellow and then a blue one.	yellow, obscurely bifasciate with brown.
<i>Spines of the hind tibiæ</i> white with black tips.	reddish.
<i>Median sulcus of supraanal plate of</i> ♂ extending only one-half its length.	extending to tip.
<i>Male cerci</i> decurved, the lower margin arcuate.	straight, the lower margin straight.

3 ♂, 7 ♀. It is slightly smaller than *C. vivax* and was taken at Las Vegas, Oct. 5, at an open grassy place by W. P. Cockerell, Ada Springer, and T. D. A. Cockerell. It is a very lively grasshopper.

Hesperotettix viridis (Thomas).—La Trementina, July 8, 16 (Miss Alice Blake); Chaves, Sept. 6 (Townsend); Mesilla Valley, quite common on *Bigelovia heterophylla*, var. *wrightii*; colored like its food plant, which it never leaves for cultivated fields (Cockerell).

Figured rudely by Glover in his Illustrations, pl. 11, fig. 3; for genitalia, see Scudder's Rev. Mel., pl. 4, fig. 8.

Hesperotettix pacificus Bruner.—Eagle Creek, White Mts. (Wooton, in Morse's coll.).

Genitalia figured in Scudder's Rev. Mel., pl. 5, fig. 1.

Hesperotettix pratensis Scudder.—Pecos River,—Tex. or N. Mex. (Pope).

Genitalia figured in Scudder's Rev. Mel., pl. 5, fig. 3.

Hesperotettix speciosus (Scudder).—Reported from New Mexico by Bruner; Pecos River,—Tex. or N. Mex. (Pope).

Figured in Glover's Illustrations, pl. 11, fig. 1; genitalia in Scudder's Rev. Mel., pl. 5, fig. 4.

Æoloplus elegans Scudder.—Las Cruces, Aug. 8 (Cockerell); Mesilla Park and road to Las Cruces, June 27, 30. July 2 (Morse); Mesilla Park, July 8, on *Atriplex canescens*, in coitu; the pair are very

different in coloration, the ♀ being nearly uniform green, the ♂ rather heavily marked with fuscous, after the style of *Æ. regalis*.

The tegmina are by no means always immaculate, as in the single type.

Colored like food plant which it never leaves for the cultivated field (Cockerell). It is extremely abundant on the *Atriplex* at Mesilla Park.

Genitalia figured in Scudder's Rev. Mel., pl. 5, fig. 6.

Æoloplus regalis (Dodge).—Pecos River,—Tex. or N. Mex. (Pope).

Genitalia figured in Scudder's Rev. Mel., pl. 5, fig. 7.

Æoloplus crassus Scudder, sp. nov.—Robust. Head flavo-testaceous or olivaceous above, with a broad greenish blue stripe, sometimes accentuated with fuscous, broadening posteriorly, and a postocular fuscous band; frontal costa subequal, but slightly narrowest above, about as broad as the interspace between the eyes, plane; antennæ dull ferruginous, apically infuscated. Pronotum obtusely angulate behind, the angle rounded, truncate in front, the median carina feeble on the prozona, obsolescent between the sulci, distinct on the metazona, the lateral carinæ forming rounded shoulders, the prozona with a transverse submarginal sulcus most distinct on the lateral lobes; the whole varying from olivaceous to testaceous, more or less distinctly striped longitudinally and broadly above with darker shades, the lateral lobes darker on the prozona, the whole metazona generally olivaceous. Prosternal spine coarse, conical, very blunt. Tegmina generally extending a little beyond the abdomen, rather broad, tapering apically and well rounded at tip, brownish fuscous, with quadrate alternating testaceous and blackish fuscous patches along the middle; hind wings rather broad and scarcely so long as the tegmina, pellucid with a faint bluish tinge due in part at least to the color of the veins, very faintly infuscated at extreme tip. Hind femora olivaceous sometimes inclining to testaceous, thrice banded rather conspicuously and broadly with blackish fuscous; hind tibiae pale blue with a postgenicular fuscous annulus, the spines black but pallid at base.

Length of body (largest specimen), 31 mm.; tegmina, 21.5 mm.; hind femora, 17 mm.

4♀. Mescalero Reservation (Cockerell); San Luis Potosi, Mex. (Palmer).

Æoloplus turnbulli (Thomas).—Reported from New Mexico by Bruner.

Figured in Glover's Illustrations, pl. 11, fig. 10; genitalia in Scudder's Rev. Mel., pl. 5, fig. 10.

Eoloplus plagosus (Scudder).—Northern New Mexico, Aug., Sept. (Carpenter).

Genitalia figured in Scudder's Rev. Mel., pl. 6, fig. 1.

Podisma stupefacta (Scudder).—Taos Peak, 13,000' (Carpenter).

Figured in Appalachia, viii, pl. 42, figs. 6, 7; the genitalia in Scudder's Rev. Mel., pl. 7, fig. 6.

Melanoplus lakinus (Scudder).—Las Vegas, Sept. 29, Oct. 26 (Cockerell); La Trementina, Sept. 9, 10, Oct. 3 (Alice Blake); Mescalero, Oct. 2, on *Bigelovia graveolens glabrata* (Cockerell); Las Cruces (Cockerell); Mesilla (Cockerell, in Morse's coll.).

Both macropterous and brachypterous forms were found; the latter appears to be the predominant form here as elsewhere, and may be regarded as typical; the former may bear the varietal name *refertus* Scudder.

Genitalia figured in Scudder's Rev. Mel., pl. 10, fig. 2.

Melanoplus occidentalis (Thomas).—Ft. Wingate (U. S. nat. mus.); Johnson's Basin, June 22 (Townsend); Magdalena (Univ. Kans.).

Figured in Glover's Illustrations, pl. 11, fig. 2; the genitalia in Scudder's Rev. Mel., pl. 10, fig. 4.

Melanoplus cuneatus Scudder.—Silver City (U. S. nat. mus.).

Genitalia figured in Scudder's Rev. Mel., pl. 10, fig. 5.

Melanoplus flabellifer Scudder.—Johnson's Basin, June 22 (Townsend).

Genitalia figured in Scudder's Rev. Mel., pl. 10, fig. 6.

Melanoplus herbaceus Bruner.—Albuquerque, Aug. (Snow); Las Cruces (Townsend); Mesilla Park, ovipositing in October (Cockerell); occurred in immense numbers on *Pluchea borealis*, which it resembles in color and which it never leaves for cultivated fields.

Figured in Bull. 28, div. ent. U. S. dep. agric., fig. 13ab; the genitalia in Scudder's Rev. Mel., pl. 10, fig. 10.

Melanoplus flavescens Scudder.—Mesilla and Mesilla Park, June 27, 30 (Morse); Mesilla, Oct. 14 (Cockerell).

Genitalia figured in Scudder's Rev. Mel., pl. 11, fig. 1.

Melanoplus bowditchi Scudder.—Belen, Aug. 7 (Townsend); Sabinal (Townsend); Chaves, Aug. 6 (Bruner); Las Cruces, July 8 (Cockerell).

Genitalia figured in Scudder's Rev. Mel., pl. 11, fig. 3.

Melanoplus flavidus Scudder.—Las Cruces, July 8 (Cockerell).

Genitalia figured in Scudder's Rev. Mel., pl. 11, fig. 4.

Melanoplus elongatus Scudder.—Las Cruces, July 8 (Cockerell); Mesilla and Mesilla Park, June 30 (Morse).

Genitalia figured in Scudder's Rev. Mel., pl. 11, fig. 5.

Melanoplus glaucipes (Scudder).—Mesilla Park, June 27 (Morse).

Genitalia figured in Scudder's Rev. Mel. pl. 11, fig. 6.

Melanoplus bruneri Scudder.—Beulah, July 25 (Cockerell).

Genitalia figured in Scudder's Rev. Mel., pl. 11, fig. 7.

Melanoplus excelsus Scudder.—Aqua Fria Park, Colfax Co., 8800', Aug. (E. Atkins). This species has been found before only above timber in Colorado. The specimen is somewhat slenderer than those found at higher altitudes.

Figured in Appalachia, viii, pl. 42, figs. 4, 5: the genitalia in Scudder's Rev. Mel., pl. 11, fig. 9.

Melanoplus scitus Scudder, sp. nov.—Brownish fuscous, marked with fuscous. Head plumbeo-fuscous, the vertex flavo-testaceous, very broadly striped mesially with an expanding fuscous band and followed behind the eyes with piceous; vertex rather tumid and raised well above the level of the pronotum; interspace between the eyes hardly broader than first antennal joint; fastigium rather shallowly sulcate; frontal costa about as broad as interspace between the eyes, subequal, reaching the clypeus, slightly sulcate at and below the ocellus; eyes moderately prominent, longer than the infraocular portion of the genæ; antennæ ferruginous, less than three-fourths as long as hind femora. Pronotum brownish fuscous with the front margin transverse, the hind margin obtusely angulate, the median carina distinct on the metazona, hardly perceptible on the prozona, the latter transversely rounded and passing without carinæ into the subvertical lateral lobes, the disk smooth, subquadrate, barely longer than the finely punctate metazona; lateral lobes with the upper half of the posterior half of the metazona marked with fuscous. Prosternal spine slightly inclined, rather long, feebly conical; interspace between mesosternal lobes more than twice as long as broad, widening posteriorly; metasternal lobes attingent. Tegmina surpassing the tips of the hind femora, rather feebly punctate with fuscous along the middle line. Fore and middle legs dull flavo-testaceous; hind femora bright orange beneath and within, without dull flavo-testaceous thrice obliquely fasciate with fuscous; hind tibiae glaucous. Extremity of male abdomen

barely clavate, not recurved, the supraanal plate with a deep percurrent median sulcus between high and narrow walls; furcula consisting of a pair of flattened, arcuate, slightly outcurved fingers nearly reaching the middle of the supraanal plate; cerci subequal compressed straight but slightly incurved plates, about two and a half times as long as broad, apically rounded, and the apical half of the outer face dimpled; subgenital plate subhastrate, the apical margin somewhat elevated pyramidally but not to so great an extent as in the other members of the *utahensis* series to which it appears to belong.

Length of body, 23 mm.; antennæ, 9 mm.; tegmina, 21 mm.; hind femora, 13.5 mm.

1 ♂. La Trementina, Aug. 23 (Miss Alice Blake).

Melanoplus atlantis (Riley).—South fork of Eagle Creek, White Mts., c. 8000', Aug. 19 (Townsend); Las Cruces (Cockerell); Mesilla, June 20 (Morse).

The best figures will be found in the Rep. U. S. ent. comm., i, pl. 3.

Melanoplus spretus (Uhler).—Not a permanent inhabitant. Glover in 1874 credited it to New Mexico; where it breeds according to Dodge (Can. ent., vii, 134). Taos in 1875-1876 (Gusdorf in Rep. U. S. ent. comm.); Taos Peak, 13,000', July 1875 (Carpenter); Rio Arriba Co., 1874 (Packard); Colfax Co., 1873 (Packard); Bernalillo Co., 1878 (Packard); Santa Fé Co., 1865, 1871, 1874, 1877 (Packard); Valencia Co., 1868 (Packard). In the Rep. U. S. ent. comm., ii, 159, Packard says that in the year 1868 it "seemed to have extended farther south than [in] any year before or since, so far as we could ascertain. As ex-Gov. Army informed us, the farthest point south to which they flew was 140 miles south of Santa Fé; this would carry the southern limits of the region periodically visited by this species of locust as far south as Ft. Craig on the Rio Grande River in Socorro Co. So that we may infer that occasionally, though rarely, the northern two-thirds of New Mexico, *i. e.*, the portion lying north of the 34th parallel, are liable to invasion from locusts breeding in the Arkansas and San Juan valleys of southern Colorado."

Nothing has been seen of it during the years (since 1893) that Mr. Cockerell has lived in New Mexico; all reports of injury by grasshoppers have proved due to resident species.

The best figures will be found in the Rep. U. S. ent. comm., i, pl. 1.

Melanoplus aridus (Scudder) — Las Vegas Hot Springs, 7000', Sept. (Cockerell); Dripping Springs, Organ Mts., Aug. (Cockerell); about

two miles from Mesilla toward Las Cruces, on herbage, June 30 (Morse); Mesilla, Oct. 14 (Cockerell). This species is usually found on grass in the Mesilla Valley; though common, it seems not to enter cultivated fields.

Figured in Rep. Wheeler's Surv., v, pl. 45, figs. 1, 2; the genitalia in Scudder's Rev. Mel., pl. 14, fig. 3.

Melanoplus gillettei Scudder.—Beulah, Aug. (W. P. Cockerell). Top of Las Vegas range, 11,000', Sept. 1 (W. P. Cockerell). These specimens appear to belong here, although the hind tibiæ are pale reddish and not glaucous and the furcula of the male is not so slender as in the types.

Figured in Appalachia, viii, pl. 43, figs. 1, 2; the genitalia in Scudder's Rev. Mel., pl. 14, fig. 7.

Melanoplus dawsoni (Scudder).—Northern New Mexico, Aug., Sept. (Carpenter).

Figured in Lugger's Orth. Minn., figs. 109, 110; details in Scudder's Rev. Mel., pl. 1, fig. a, pl. 15, fig. 5.

Melanoplus cockerelli Scudder.—Ridge between Sapello and upper Pecos Rivers (Cockerell); Beulah, July 27 (Cockerell); Crew's Mesa above Beulah, c. 8800', Aug. 9 (Cockerell).

Melanoplus palmeri Scudder.—Ft. Wingate (U. S. nat. mus.). Personally collected by Dr. Shufeldt.

Genitalia figured in Scudder's Rev. Mel., pl. 15, fig. 7.

Melanoplus altitudinum (Scudder).—Northern New Mexico, Aug., Sept. (Carpenter); Taos Peak, 13,000' (Carpenter); ridge between Sapello and upper Pecos Rivers, Aug. (Cockerell).

Figured in Appalachia, viii, pl. 43, figs. 3, 5; the genitalia in Scudder's Rev. Mel., pl. 16, fig. 1.

Melanoplus neomexicanus Scudder, sp. nov.—Of rather small size, dark olivaceo-fuscous with black markings. Head hardly prominent, darker above, with an obscure broad blackish postocular stripe; vertex moderately tumid, elevated slightly above the pronotum, the interspace between the eyes nearly twice as broad as the first antennal joint; fastigium considerably declivent, broadly sulcate; frontal costa about as broad as the interspace between the eyes, equal, plane, not reaching the clypeus, seriatly punctate laterally; eyes slightly prominent in both sexes, about as long as the infraocular portion of the genæ; antennæ dull ferruginous becoming infuscated apically, in the female

but little more than half as long as the hind femora. Pronotum feebly expanding posteriorly, the lateral lobes with a blackish patch above on the prozona; disk passing into the lateral lobes by a rounded shoulder, more distinct in the female than in the male, the median carina slight and equal but sometimes obsolescent between the sulci; front margin faintly convex, hind margin roundly and very broadly angulate; prozona longitudinally subquadrate, about a third longer than the feebly punctate metazona. Prosternal spine short, blunt, conical; interspace between mesosternal lobes about half as long again as broad in both sexes. Tegmina abbreviate, slightly shorter (σ) or longer ($\bar{\sigma}$) than the pronotum, attingent (σ) or overlapping ($\bar{\sigma}$), subacuminate ($\bar{\sigma}$) or rounded subacuminate (σ). Fore and middle femora of male somewhat tumid; hind femora slender, fusco-olivaceous, banded and streaked with fuscous, flavous on most of inner face; hind tibiae green with black-tipped pallid spines. Extremity of male abdomen clavate, a little recurved, the supraanal plate small, triangular, nearly plane, but with a rather broad and shallow median sulcus; furcula wanting; cerci erect, incurved, moderately broad at base, but immediately contracting to form a slender equal compressed round-tipped finger; subgenital plate small, bluntly conical, with an obscure large apical tubercle.

Length of body, σ , 17.5 mm.; $\bar{\sigma}$, 23 mm.; antennæ, $\bar{\sigma}$, 7 mm.; tegmina, σ , 4 mm., $\bar{\sigma}$, 5 mm.; hind femora, σ , 11.5 mm., $\bar{\sigma}$, 12 mm. 1 σ , 2 $\bar{\sigma}$. Las Vegas, April 13 (M. D. Cockerell).

Belongs in the *borckii* series.

Melanoplus sapellanus Scudder.— Ridge between Sapello and upper Pecos Rivers (Cockerell).

Melanoplus snowi Scudder.— Magdalena, July (Snow).

Genitalia figured in Scudder's Rev. Mel., pl. 18, fig. 7.

Melanoplus femur-rubrum (De Geer).— Tularosa (Cockerell); Little Round Mt., east of Tularosa (Wootton, in Morse's coll.); Las Cruces, July 8 (Cockerell); Mesa east of Las Cruces, c. 4000', Sept. 10 (Townsend); Mesilla (Morse).

The best figures will be found in the Rep. U. S. ent. comm., i, pl. 2.

Melanoplus terminalis Scudder.— La Trementina, Oct. 3 (Miss Alice Blake); La Cueva, Organ Mts., c. 5300', Sept. 3 (Carl H. Townsend).

Genitalia figured in Scudder's Rev. Mel., pl. 19, fig. 7.

Melanoplus cinereus Scudder.— Pecos River, — Tex. or N. Mex. (Pope). It almost certainly occurs in New Mexico, for it has also been taken in Utah and Arizona.

Figured in Rep. U. S. ent. comm., ii, pl. 17, figs. 1, 4, 5; the genitalia in Scudder's Rev. Mel., pl. 19, fig. 9.

Melanoplus coccineipes Scudder.—La Trementina, Aug. 3 (Miss Alice Blake). The specimens are unusually large and pale, and may prove a distinct species.

Genitalia figured in Scudder's Rev. Mel., pl. 20, figs. 3-5.

Melanoplus packardii Scudder.—Santa Fé, June (Cockerell).

Figured in Rep. U. S. ent. comm., ii, pl. 17, figs. 7, 8; the genitalia in Scudder's Rev. Mel., pl. 21, figs. 1-4.

Melanoplus foedus Scudder.—Reported from New Mexico by Bruner but perhaps by error.

Figured in Bull. 28, div. ent. U. S. dep. agric., fig. 9ab; the genitalia in Scudder's Rev. Mel., pl. 20, fig. 9.

Melanoplus corpulentus Bruner.—Las Vegas, Oct. 4 (John McNary); Oct. 13 (Cockerell); Las Vegas Hot Springs, Sept. 12 (Cockerell); Eagle Creek, White Mts., 7000', Aug. 10-16 (Wooton, in Morse's coll.); Ruidoso, White Mts. (Wooton, in Morse's coll.); Silver City (Marsh, t. Bruner).

Genitalia figured in Scudder's Rev. Mel., pl. 20, fig. 10.

Melanoplus bicoloratus Scudder, sp. nov.—Medium sized, dark fuscous, more or less tinged with testaceous. Head moderately prominent, fusco-testaceous, darker above with a broad black postocular band; vertex gently tumid, scarcely elevated above the pronotum, the interspace between the eyes somewhat broader than the first joint of the antennæ; fastigium steeply declivent, broadly and considerably sulcate; frontal costa failing to reach the clypeus, subequal but slightly narrowed at summit, fully as broad as the interspace between the eyes, plane, but depressed at the ocellus, serially punctate at the sides above; eyes moderate, about as long as the infraocular portion of the antennæ; antennæ ferruginous-testaceous, apically infuscated, about three-fourths as long as the hind femora (♂). Pronotum rather stout, enlarging somewhat on the metazona, the lateral lobes subpicaceous on the upper half of the prozona, the front margin tinged with testaceous; front margin slightly convex and faintly emarginate, hind margin distinctly angulate; median carina feeble on prozona, distinct on metazona; lateral carinae distinct, percurrent; prozona quadrate, as long as the feebly punctate metazona. Prosternal spine moderately long, cylindrical, blunt, slightly inclined; interspace between mesosternal lobes (♂) subquadrate, the metasternal lobes attingent. Tegmina sur-

passing considerably the hind femora, brownish fuscous, punctate with fuscous down the middle. Fore and middle femora a little tumid; hind femora stout, fusco-testaceous marked with fuscous, especially marked above with two blackish fuscous patches and a pregenicular annulus, the inner and lower face red; hind tibiæ glaucous with black-tipped spines. Extremity of male abdomen clavate, a little recurved, the supraanal plate formed of two portions, the basal subquadrate but much broader than long, the apical on a lower plane, triangular; furcula consisting of two minute, short, divergent fingers; cerci straight but strongly incurved, subequal plates, a little constricted in the middle, the apex well rounded, the apical half externally sulcate and the whole three or four times as long as middle width; subgenital plate haustrate, the margin regularly rounded, of even elevation.

Length of body, 23.5 mm.; antennæ, 9.5 mm.; tegmina, 22 mm.; hind femora, 13 mm.

1 ♂. La Cueva, Organ Mts., c. 5300', Sept. 3 (Townsend).

Belongs in the packardii series.

Melanoplus compactus Bruner.—La Trementina, Oct. 4 (Miss Alice Blake). Found in the stomach of a gull shot near Las Vegas, but was very likely not eaten by the gull in New Mexico; see Bull. 37, N. M. agric. exper. stat., p. 40.

Genitalia figured in Scudder's Rev. Mel., pl. 21, fig. 6.

Melanoplus calidus Scudder.—Eagle Creek, White Mts., 7000', Aug. 10-16 (Wooton, in Morse's coll.); south fork of Eagle Creek, White Mts. (t. Cockerell).

Melanoplus quadratus Scudder, sp. nov.—Of moderately large size. Head olivaceo-fuscous with a rather broad postocular fuscous stripe, hardly prominent, the vertex somewhat tumid especially in the male, slightly elevated above the pronotum, the interspace between the eyes a little wider, especially in the female, than the first antennal joint; fastigium rather steeply declivent, very shallowly sulcate, enlarging and well rounded anteriorly; frontal costa broad, equal, plane, but depressed slightly at the ocellus, percurrent, very feebly punctate; eyes scarcely more prominent in the male than in the female, scarcely longer than the infraocular portion of the genæ; antennæ three-fourths as long as the hind femora in the male, ferruginous, apically infuscated. Pronotum fuscous, more or less tinged with testaceous or olivaceous, with obscure paler stripes following the inner side of the lateral carinæ, of nearly equal breadth, but slightly enlarging posteriorly in the female,

the front border faintly convex, the hind border feebly angulato-convex: median carina slight, equal, but in the male obolescent between the sulci; the lateral carinae fairly distinct; prozona slightly (φ) or distinctly (σ) longitudinal, a third longer than the feebly granulate metazona. Prosternal spine long, conical, bluntly pointed, a little retrorse; meso- and metasternum coarsely, sparsely, and feebly punctate; interspace between mesosternal lobes twice as broad as long (σ) or subquadrate (φ). Tegmina fusco-testaceous, abbreviate, attinent, a little shorter than head and pronotum together, nearly twice as long as broad, both margins, but especially the costal, considerably convex, the tip roundly pointed. Fore and middle femora somewhat tumid in the male; hind femora dark olivaceous or testaceous, lighter beneath, the hind tibiae red with black spines. Extremity of male abdomen a little clavate, a little recurved, the supraanal plate long shield-shaped, pointed, the sides sinuate with a rather narrow and deep median sulcus in basal half; furcula very slight, consisting of hardly more than a biangulate margin, the angles somewhat distant; cerci about twice as long as broad, broadly and equally rounded apically, subrectangulate but a little narrowed mesially, feebly incurved, reaching back almost as far as the supraanal plate; subgenital plate rounded, a little elevated and thickened apically.

Length of body, σ , 22 mm., φ , 27 mm.; antennae, σ , 9 mm.; tegmina, σ , 6 mm., φ , 7 mm.; hind femora, σ , 12 mm., female, 13.5 mm.

1 σ , 1 φ . South fork of Eagle Creek, White Mts., c. 8100', in coitu, Aug. 20 (Townsend).

Belongs in the texanus series.

Melanoplus differentialis (Uhler).—La Trementina, Oct. 3 (Miss Alice Blake); Albuquerque, Sept. 17 (Cockerell); Pecos River, June 20,—Tex. or N. Mex. (Pope); Sabinal, Aug. 7 (Townsend); Socorro, May (U. S. nat. mus.); Tularosa (Cockerell); Las Cruces (Cockerell); Mesilla, June 28 (Morse). A destructive species in the Mesilla Valley.

Figured in Glover's Illustrations, pl. 8, fig. 12, pl. 9, fig. 4, pl. 11, fig. 6; Bull. 28, div. ent. U. S. dep. agric., fig. 5; and Lugger's Orth. Minn., figs. 131, 132; the genitalia in Scudder's Rev. Mel., pl. 23, figs. 3, 4.

Melanoplus robustus (Scudder).—Organ Mts. (Wooton, in Morse's coll.).

The specimens probably belong here; if not, they represent a new species.

The species is figured in Bull. 28, div. ent. U. S. dep. agric., figs. 6, 7; the genitalia in Scudder's Rev. Mel., pl. 25, fig. 5.

Melanoplus bivittatus (Say).—Taos (U. S. nat. mus.); Beulah, Aug., Sept. 3 (W. P. Cockerell); Las Vegas Hot Springs, Sept. 12 (Cockerell); Santa Fé (Cockerell); Pecos River,—Tex. or N. Mex. (Pope); Las Vegas (Cockerell).

A species of relatively high altitudes, where it abounds, taking the place of *M. differentialis* of lower down. Pope found both these species on the Pecos River, but doubtless at very different places.

Figured in Glover's Illustrations, pl. 1, fig. 16; and Lugger's Orth. Minn., figs. 133, 134; the genitalia in Scudder's Rev. Mel., pl. 24, fig. 4.

Melanoplus thomasi Bruner.—Tularosa, Sept. (Cockerell). It was found abundantly at Tularosa, but nowhere else. It occurred in gardens, and doubtless is capable of injury to crops.

Genitalia figured in Scudder's Rev. Mel., pl. 25, fig. 1.

Phætaliothes nebrascensis (Thomas).—It probably occurs in New Mexico, for it is known from Texas, Mexico, Arizona, and northward.

Figured in Lugger's Orth. Minn., fig. 137; details in Scudder's Rev. Mel., pl. 1, fig. e, pl. 25, figs. 6, 7.

Dactylotum pictum (Thomas).—Plains of northern New Mexico, eastern slope, Oct. 14-31 (Carpenter); northern New Mexico, Aug., Sept. (Carpenter).

Figured in Glover's Illustrations, pl. 8, fig. 4; and in Spec. bull. 2, dep. ent. univ. Nebr., fig. 4a.

Dactylotum variegatum (Scudder).—New Mexico (Bruner); Las Vegas, July 31 (K. M. Chapman); La Cueva, Organ Mts., c. 5300', Aug. 30, 31 (Townsend); West side of Organ Mts. at Riley's Ranch, La Cueva, Sept. 14 (Wooton, in Morse's coll.); Grant Co. (W. J. Howard, fide Townsend).

LOCUSTIDÆ.

PHANEROPTERINÆ.

Dichopetala emarginata Bruner.—Mesilla Park, common on *Atriplex canescens* (Cockerell).

Dichopetala brevicauda Scudder, sp. nov. (Pl. 4, fig. 1).—Olivaceous-testaceous, more or less rufescent on the body; the top of the head, a postocular stripe, and on the pronotum a broken bent arcuate stripe on either side in the position of lateral carinæ, pallid. Pronotum meso-

ally constricted, especially in the male, the hind margin truncate (♂) or feebly emarginate (♀). Tegmina in male about as long as pronotum, overlapping, the inner margin strongly rounded, in no way angulate, brownish fuscous with pallid veins; in female minute lateral well-rounded pads. Femora greenish becoming testaceous apically, the hind pair more or less, generally little, punctate or blotched with fuscous on outer and inner faces. Dorsum of abdomen obscurely tinged with ferruginous. Cerci of male stout, the basal half feebly tapering, incurved, dividing apically into two incurved tapering hooks, the outer one half the size of the inner: subgenital plate terminating in two blunt conical processes, the interval between them somewhat acutangulate. Ovipositor testaceous, apically infuscated especially on lower margin, hardly longer than the fore femora, the margins of the apical fourth finely serrato-dentate; subgenital plate of female deeply and broadly rotundato-emarginate.

Length of body, ♂, 14 mm., ♀, 20.5 mm.; pronotum, ♂, 3.75 mm., ♀, 5 mm.; fore femora, ♂, 11 mm., ♀, 8 mm.; hind femora, ♂, 21 mm., ♀, 21.5 mm.; ovipositor, 7.5 mm.

1 ♂, 2 ♀. Riley's ranch, Mesilla Valley, Aug. 16 (Cockerell); College campus, Mesilla Park, on *Atriplex canescens*, Aug. 7, (Cockerell); Mesilla Park, Sept. 11 (Cockerell). I have specimens also from Mexico.

The female is remarkable for the brevity of the fore femora and ovipositor.

Hormilia elegans Scudder.—Las Cruces, Oct. (Cockerell); two miles from Mesilla on road to Las Cruces, along irrigation ditch, June 30 (Morse). A vagrant species, often wandering into the streets, or presenting itself on private premises.

Figured in Proc. Dav. acad., viii, pl. 3, fig. 1.

Arethaca gracilipes (Thomas).—La Trementina, July 15 (Alice Blake). Figured in Glover's Illustrations, pl. 11, fig. 11.

Arethaca constricta Brunner.—In an arroyo ten miles west of La Luz, Aug. 23 (Townsend); near Organ Mts., Mesilla Valley, Aug. (Cockerell).

Arethaca carita Scudder, sp. nov. (Pl. 4, fig. 5).—Green, the antennæ and tibiæ luteous, the disk of the pronotum with a light luteous patch or bar on front margin behind the upper edge of the eyes, and with the hind margin luteous, delicately edged anteriorly with ferruginous. Pronotum a little elevated anteriorly. Tegmina abbreviate, less than twice as long as the pronotum, the apical half hardly more

than half as wide as the basal half, the radial vein with only three branches; hind wings not surpassing the tegmina. Hind femora less than a third longer than the body, the genicular lobes rather bluntly acuminate.

Length of body, 19 mm.; pronotum, 4 mm.; tegmina, 7 mm.; fore femora, 10 mm.; hind femora, 25.5 mm.; ovipositor, 4.5 mm.

1 ♀. Mesilla Park, Sept. 12 (Cockerell).

Scudderia furcifera Scudder — Dripping Springs, Organ Mts (Cockerell); La Cueva, Organ Mts., c. 5300', Sept. 2 (Townsend).

Genitalia figured in Proc. Amer. acad., xxxiii, 282, pl., fig. 7.

Scudderia furcata Brunner. — New Mexico (Meske, t. Bruner): Raton, Sept. (W. P. Cockerell).

Figured in Brunner's Mon. Phan., fig. 72a; Biologia centr. amer., pl. 15, figs. 16, 17; and Lugger's Orth. Minn., figs. 141-143.

Microcentrum retinerve (Burmeister). — La Trementina (Miss Alice Blake); Mesilla, Nov. 17 (Cockerell in Morse's coll.).

Occurs on fruit trees, and may have been spread beyond its natural range, the eggs being easily transported on young trees. It is never abundant enough in New Mexico to be a serious cause of injury.

Figured in Glover's Illustrations, pl. 4, fig. 3; Biologia centr. amer., pl. 17, figs. 6-8; and in Riley's Rep. ins. Mo., vi, figs. 43-47.

CONOCEPHALINÆ.

Xiphidium strictum Scudder. — Mesilla Park, July 16 (Cockerell); Probably this species: only immature specimens seen. They occurred in a grassy place on the College farm.

Xiphidium fasciatum (De Geer) — Las Vegas Hot Springs, Sept. 12 (Cockerell).

Often figured. See Glover's Illustrations, pl. 4, fig. 10; and Lugger's Orth. Minn., figs. 157, 158.

DECTICINÆ.

Stipator minutus (Thomas). — Northeastern New Mexico (Thomas): La Trementina, July 18, 23 (Miss Alice Blake).

Figured in Glover's Illustrations, pl. 11, fig. 17.

Stipator stevensoni (Thomas). — Northeastern New Mexico (Thomas).

Figured in Glover's Illustrations, pl. 18, fig. 19.

Anabrus coloradus Thomas.—Taos Peak (Carpenter); Aqua Erfa Park, Colfax Co., 8800', Aug. (E. Atkins); Beulah, Sept. 3, and top of ridge, Aug. 28 (W. P. Cockerell).

Anabrus purpurascens Uhler.—Northern New Mexico (Thomas).

Figured in Glover's Illustrations, pl. 17, figs. 10, 11; Rep. U. S. ent. comm., ii, pl. 8, fig. 6; and Luzger's Orth. Minn., figs. 161, 162.

Eremopedes scudderi Cockerell.—Mesilla Park, July, Aug. 4 (Cockerell). Female specimens found at the latter date, the dorsum having "a broad ochreous band from vertex to end of abdomen," are given the varietal name *bicolor* by Cockerell. The green form was named *viridis* Cockerell.

This species was found hiding in an outhouse, and is doubtless nocturnal.

Eremopedes popeana Scudder, sp. nov. (Pl. 4, fig. 2).—Light olive green, mottled with darker green and with luteous, especially on dorsum of pronotum and abdomen, but the whole often much embrowned. Head full, uniformly olive green or testaceous, without markings, the fastigium rather prominent, rounded; antennæ very slender, about twice as long as the body. Pronotum shaped as in *E. unicolor*, truncate behind in both sexes. Tegmina of male small, compact, full, apically subtruncate, extending beyond pronotum by about one-third its length, in the female reduced to minute ovate lateral pads. Legs long and slender, the fore tibiæ with three spines above on outer margin and occasionally, at least in female, and sometimes only on one side of the body, one or two spines on inner margin. Ovipositor fully as long as the body and considerably longer than the hind femora, considerably arcuate, but only in apical half, testaceous, becoming infuscated apically along the edges, rather finely acuminate at tip.

Length of body, ♂, 27 mm., ♀, 23 mm.; pronotum, ♂, 7.25 mm., ♀, 7 mm.; antennæ, ♂, c. 45 mm.; fore femora, ♂, 6 mm., ♀, 5.5 mm.; hind femora, ♀, 21.5 mm.; ovipositor, 24 mm.

1 ♂, 4 ♀. Little Round Mt., 9 miles east of Tularosa, 5000', Aug. 24 (Wootton in Morse's coll.); Pecos River, —Texas or N. Mex., June 27, June 30, Aug., (Capt. John Pope).

The occasional presence of spines on the inner margin of the fore femora above shows that this distinction cannot strictly separate, as the shape of the ovipositor does, *Eremopedes* from *Cacopterus*.

The known species of *Eremopedes* may be separated, as follows:

a¹. Ovipositor longer than hind femora, arcuate only in apical half.
popeana.

a². Ovipositor shorter or at least no longer than hind femora, uniformly arcuate throughout.

b¹. Hind femora more than three times as long as pronotum, and longer than body; ovipositor barely shorter than hind femora.

scudderi.

b². Hind femora distinctly less than three times as long as pronotum and a little shorter than body; ovipositor distinctly shorter than hind femora.

unicolor.

Stiroxys trilineata (Thomas).—Northeastern New Mexico (Thomas).

Figured in Glover's Illustrations, pl. 8, fig. 5; and in Verhandl. zool.-bot. gesellsch. Wien, xxiv, pl. 5, figs. 64-69.

Plagiostira albonotata Scudder.—Northern New Mexico, Aug., Sept. (Carpenter); Albuquerque, Sept. 17, (Cockerell).

Plagiostira albofasciata Scudder and Cockerell, sp. nov. (Pl. 3, fig. 2). Approaches *Clinopleura* by its relatively narrow pronotal disk, and somewhat inclined lateral lobes. Apple green, conspicuously marked with a pair of laterodorsal white stripes, edged on both sides with dull pink, running from behind the upper edge of the eyes across the prothorax and abdomen, on the prothorax converging to the anterior sulcus and thereafter subparallel (marking the position of the lateral carinae, were they present), on the abdomen subparallel, but at first diverging feebly and then converging a little more; the lower margin of the lateral lobes of the pronotum edged as broadly with white, the white margined above with pink, and this white stripe continues forward upon the head embracing the lower margin of the eye: the vertical sides of the fastigium are white basally, edged above with pink; eyes yellow with a large dark purplish patch: antennae with the basal joints green, beyond luteous, soon passing into testaceous. Legs green, the fore and middle femora faintly infuscated. Dorsal scutes of abdomen edged posteriorly and inferiorly with white, the white margined within with pink. Ovipositor a little longer than the hind femora, green, becoming testaceous apically, very feebly upcurved. Hind border of pronotum slightly emarginate. Tegmina feeble pads concealed beneath the pronotum. Hind tibiae of the same length as the femora.

Length of body, 29 mm.; pronotum, 7 mm.; fore femora, 8 mm.; hind femora, 27 mm.; ovipositor, 29 mm.

1 ♀. Mesilla Park, Aug. 12, on *Atriplex canescens* (Cockerell).

The chief colors were noted, as above, in life.

STENOPELMATINÆ.

Stenopelmatus oculatus Scudder.—Eagle Creek, White Mts., 7000' (Wooton, in Morse's coll.); at light, Rio Ruidoso, White Mts., c. 6500' (Townsend); Cantonment Burgoyne (t. Scudder); Las Cruces, Sept. (Cockerell). Commonly known as the "niña del tiená."

Haldeman described very insufficiently a species from Chihuahua, Mex., and Santa Fé, N. Mex., under the name of *S. fuscus*, which is possibly this.

Figured, under the name *S. hydrocephalus*, in the Biol. centr. amer., pl. 14, fig. 4.

Ceuthophilus ensifer Packard.—Mesilla Park, Sept. 12 (Miss Helen Mac Gregor).

Figured in the Amer. nat., xv, pl. 7, fig. 4.

Ceuthophilus arizonensis Scudder.—Ft. Wingate (Shufeldt).

Ceuthophilus uniformis Scudder.—Plains of northern New Mexico, eastern slope, Oct. 14 (Carpenter).

Ceuthophilus rufus Scudder.—Santa Fé, July (Cockerell); Beulah, Aug. 9 (Cockerell); White Mt. region, Aug. (Wooton, in Morse's coll.). At Beulah it occurs on a damp hillside.

Figured in Appalachia, viii, pl. 44, figs. 3, 4.

Ceuthophilus politus Scudder, sp. nov. (Pl. 4, fig. 3).—Body polished dark mahogany brown, nearly uniform, but the fore and middle legs blackish. Antennæ black, less than half as long again as body. Dorsal surface of abdomen smooth. Legs rather short; fore femora distinctly broader than the middle femora, of about the same length as the pronotum and but little more than half as long as the hind femora, unarmed beneath; middle femora with 3-4 spines on the front carina, and two or three minute spines on the hind carina, the genicular spine hardly perceptible; hind femora two-thirds as long as the body, stout, about three times as long as broad, with a few scattered raised points on upper surface, the distal half of the outer and to some extent of the inner carina with distant rather small serrations; hind tibiæ scarcely shorter than the femora, nearly straight, but faintly arcuate in proximal half, moderately stout, armed beneath with one or two preapical spines besides the apical pair; spurs opposite or sub-opposite, no longer than the tibial depth, set at an angle of about 50° with the tibiæ and divaricating about as much; inner middle calcaria scarcely longer than the outer, about half as long again as the

others or as the spurs, only a little shorter than the first tarsal joint; hind tarsi less than two-fifths as long as the tibiae, the first and last joints subequal in length, the second about half as long again as the third.

Length of body, 15.5 mm.; pronotum, 5.5 mm.; fore femora, 5.25 mm.; hind femora, 10.5 mm.; hind tibiae, 10 mm.

1♂. Las Vegas, under a rock, Nov. 16 (Cockerell).

It is nearest to, but very distinct from, *C. agassizii*.

Ceuthophilus pallidus Thomas.—Plains of northern New Mexico, eastern slope, Oct. 14-31 (Carpenter); Las Cruces, eating holes in lace curtains (Townsend); Mesilla, Aug. 15 (Cockerell); Silver City (Marsh).

Figured in Glover's Illustrations, pl. 18, fig. 18.

Ceuthophilus neomexicanus Scudder. Fort Wingate (Shufeldt).

Ceuthophilus ater Scudder, sp. nov.—Uniform purplish black more or less tinged with mahogany, the hind legs more or less mahogany colored; [when alive so dark brown as to look black, the dorsum of thorax largely ferruginous]. Legs short; fore femora somewhat broader than the middle femora, no longer than the pronotum, half as long as the hind femora, the inner carina with a subapical spine; middle femora with only a subapical spine on the front carina; hind femora about two-thirds as long as the body, twice as long as the fore femora, moderately stout, about three times longer than broad, the outer carina elevated almost uniformly throughout, with 3-4 feeble distant denticulations in the distal half, quite as prominent in the female as in the male, the inner carina similarly but still more feebly marked, the intervening sulcus very narrow; hind tibiae straight, as long as the femora, beneath with a series of 3-4 recumbent spines on distal half, besides the apical pair; spurs subopposite, about as long as the tibial depth, set at an angle of about 40° with the tibia, and divaricating as much; inner middle calcaria scarcely longer than the outer, about a fourth longer than the others or than the spurs, about as long as the first tarsal joint; hind tarsi hardly more than a third as long as the hind tibiae, the first and last joints subequal, the second but little longer than the third. Ovipositor very short, feebly arcuate, armed apically beneath with two or three dull denticulations.

Length of body, ♂, 12.5 mm., ♀, 13.5 mm.; pronotum, ♂, 4.5 mm., ♀, 4 mm.; fore femora, ♂♀, 4 mm.; hind femora, ♂, 9 mm., ♀, 8 mm.; hind tibiae, ♂, 9 mm., ♀, 8 mm.; ovipositor, 2.75 mm.

1 ♂, 1 ♀, 3 immature. Las Vegas, under rocks by Gallinas River, May 25 (Cockerell).

Appears to be most nearly allied to *C. neomexicanus*.

Udeopsylla nigra Scudder.— Santa Fé, Aug. 12 (Cockerell).

Udeopsylla robusta (Haldeman).— New Mexico (Brunner); northern New Mexico, Aug., Sept. (Carpenter); Albuquerque (Wickham).

Figured in Glover's Illustrations, pl. 8, fig. 9; and in Lugger's Orth. Minn., fig. 165.

GRYLLIDÆ.

GRYLLOTALPINÆ.

Gryllotalpa cultriger Uhler.— This species is found both in Texas and California and may probably occur in New Mexico.

Details are figured in Mem. Peab. acad., i, pl. 1, figs. 13, 32, 33.

MYRMECOPHILINÆ.

Myrmecophila nebrascensis Bruner.— Santa Fé, under stones (Cockerell).

It is figured in Lugger's Orth. Minn., fig. 169; and in Psyche, ix, p. 114.

Ectatoderus borealis Scudder, sp. nov. (Pl. 4, fig. 4).— Castaneous, covered with hoary scales, mostly abraded from specimens at hand. Head castaneous or fusco castaneous, the facial protuberance with no median impressed line but slightly emarginate mesially below; antennæ fuscous, about as long as the body; last joint of palpi fully as long as the first, regularly enlarging, apically obliquely truncate. Pronotum not at all produced posteriorly even in the male, but posteriorly truncate and in the female even slightly and roundly emarginate, in both sexes broader posteriorly than long, considerably broader behind than in front, castaneous, without markings or surface sculpture, margined narrowly in front and behind with black, the lateral lobes inferiorly margined very broadly with black; tegmina wanting in ♀, in ♂ larger than the pronotum, almost wholly exposed, the oblique vein visible from its base, the speculum broader than long, ovate; legs testaceo-castaneous, the hind femora slightly infuscated apically and the hind tibiæ with fuscous blotches; middle calcar of inner side of hind tibiæ half as long as the tarsus. Abdomen castaneous more or less and sometimes much infuscated, the cerci more than half as long as the hind femora, bluntly rounded apically; ovipositor

slightly arcuate, fully half as long as body and more than two-thirds as long as hind femora.

Length of body, ♂, 8.5 mm., ♀, 10.25 mm.; pronotum, ♂, 2 mm., ♀, 2.5 mm.; breadth of pronotum posteriorly, ♂, 2.75 mm., ♀, 3 mm.; length of tegmina beyond pronotum, ♂, 3.5 mm.; hind femora, ♂, 5.5 mm., ♀, 7 mm.; cerci, ♂, 3.25 mm.; ovipositor, 5.5 mm.

2 ♂, 1 ♀. La Cueva, Organ Mts., N. Mex., Sept. 5 (C. H. T. Townsend); Julian, San Diego Co., Cal., July (E. Palmer). Subsequently received from Dripping Springs, Organ Mts. (Cockerell).

This species is most nearly related to *E. occidentalis* (*Mogoplistes occidentalis* Scudd., 1868, from Cape St. Lucas) but differs in being smaller with a relatively shorter ovipositor and a relatively broader and shorter pronotum, this part being of equal length and breadth in *E. occidentalis*. It was only after seeing the present species that the generic position of the Cape St. Lucas species (of which only imperfect females were known) was recognized.

GRYLLINÆ.

Nemobius pictus Scudder.—Colorado, near Rincon (Cockerell); Mesilla Park (Cockerell). In both cases at light, single specimens only.

Nemobius neomexicanus Scudder.—Las Cruces (Cockerell, in Bruner's coll.). Mesilla, common (Cockerell).

This and the last are attracted to light.

Figured in the Biol. centr. amer., pl. 11, fig. 25.

Gryllus integer Scudder.—Plains of northern New Mexico, eastern slope (Carpenter); Ft. Buchanan (Nevin); Organ Mts., very common, July 10 (Wooton, in Morse's coll.); Las Cruces (O. J. Cockerell, 2301); Mesilla, May 2 (Cockerell); Mesilla, June 29, 30 (Morse); Pecos River,—Tex. or N. Mex. (Pope).

Gryllus pennsylvanicus Burmeister.—Santa Fé, June, Aug. (Cockerell); Las Vegas, under rocks by Gallinas River, May 25 (Cockerell); Ft. Buchanan (Nevin); Mesilla Park, July (Cockerell, in Morse's coll.).

Figured in Glover's Illustrations, pl. 1, figs. 13, 14; and in Lugger's Orth. Minn., fig. 173.

Gryllus abbreviatus Serville.—Pecos River,—Tex. or New Mex. (Pope).

Figured in Comstock's Manual, fig. 135.

Gryllus personatus Uhler.—Pecos River,—Tex. or N. Mex. (Pope).

ÆCANTHINÆ.

Æcanthus latipennis Riley.—La Cueva, Organ Mts., c. 5300', Sept. 6 (C. H. Townsend); Fillmore Cañon, Organ Mts., c. 5700', Sept. 1 (Townsend); Dripping Spring, Organ Mts. (M. D. Cockerell); Mesilla, on an apple tree (Cockerell); the last determined doubtfully by Bruner, who says it is "a little delicate in texture for this species."

The antennal characteristics figured in Lugger's Orth. Minn., fig. 184; and in Ent. news, iii, 33, fig. 6.

Æcanthus niveus (De Geer).—Raton Mts., fide Thomas, perhaps by mistake for one of the other species.

Figured in many places; for antennal markings, see Ent. news, iii, 33, fig. 4; and Bull. amer. mus. nat. hist., vi, 269, fig. 2.

Æcanthus angustipennis Fitch.—Mesilla, June 28-30 (Morse), Oct. 14 (Cockerell).

The antennal markings figured in Lugger's Orth. Minn., fig. 179, in Ent. news, iii, 33, fig. 5, and in Bull. amer. mus. nat. hist., vi, 270, fig. 3.

Æcanthus fasciatus Fitch.—Mescalero, on Bigelovia, Oct. 2 (Cockerell), determined by Linell; Mesilla, June 28-29 (Morse).

Figured in Lugger's Orth. Minn., figs. 180-183; the antennal markings also in Ent. news, iii, 33, figs. 1, 2; and Bull. amer. mus. nat. hist., vi, 270-271, figs. 4, 5.

PLATE 1.

All the drawings are by J. Henry Blake, and are magnified two diameters.

- Fig. 1. *Bacunculus stramineus*.
2. *Eupedetes carinatus*.
3. *Homœogamia semidiaphana*.
4. *Bacillus coloradus*.

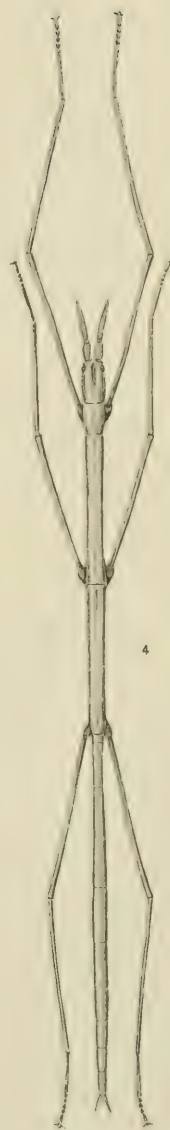
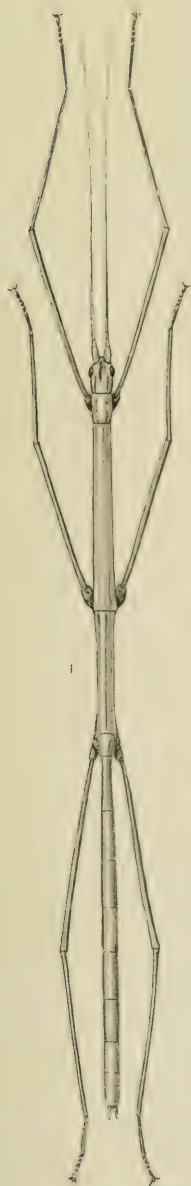


PLATE 2.

All the drawings are by J. Henry Blake, and are magnified two diameters.

- Fig. 1. *Trimerotropis alliciens*.
2. *Conozoa melleola*.
3. *Trimerotropis cyanea*.
4. *Conozoa acuminata*.

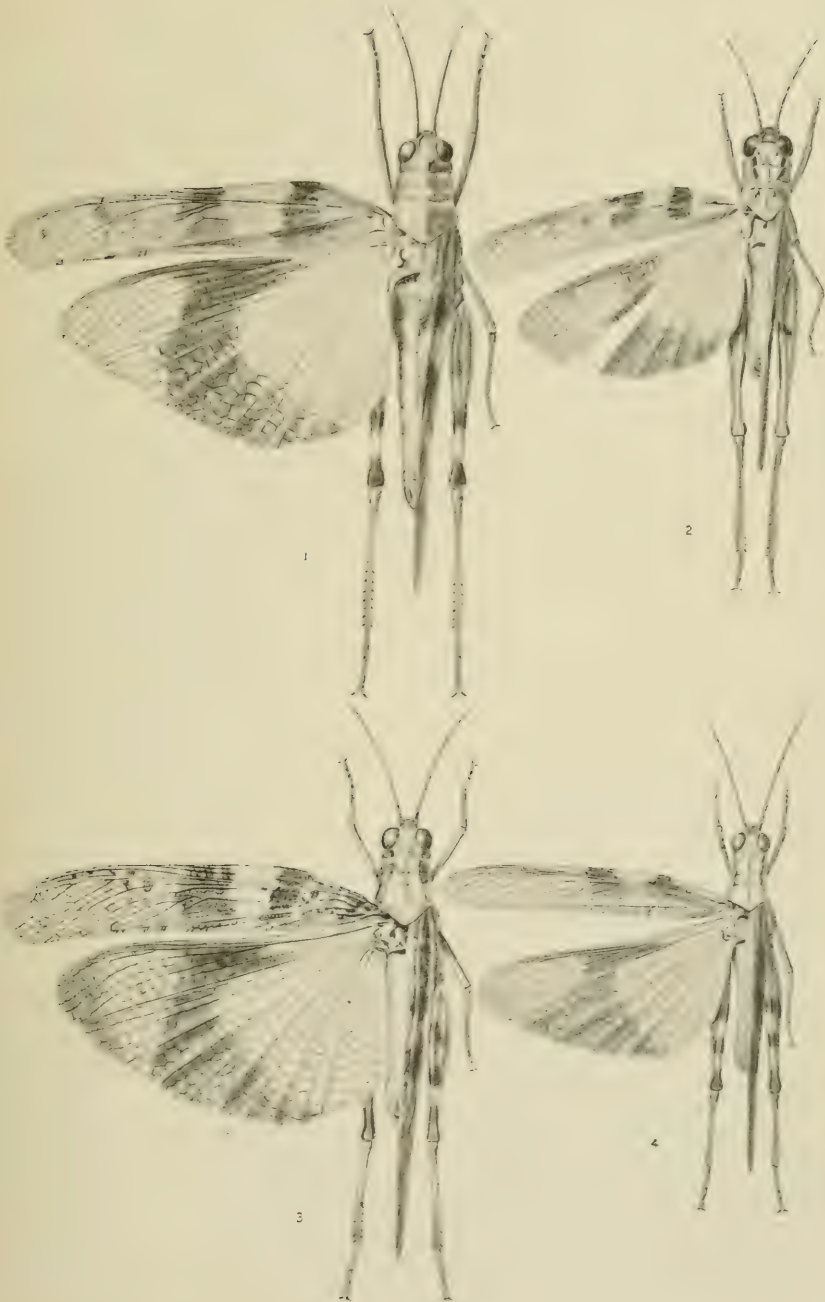


PLATE 3.

All the drawings are by J. Henry Blake, and are magnified two diameters.

- Fig. 1. *Lactista pellepidus*.
2. *Plagiostira albofasciata*.
3. *Acantherus piperatus*.

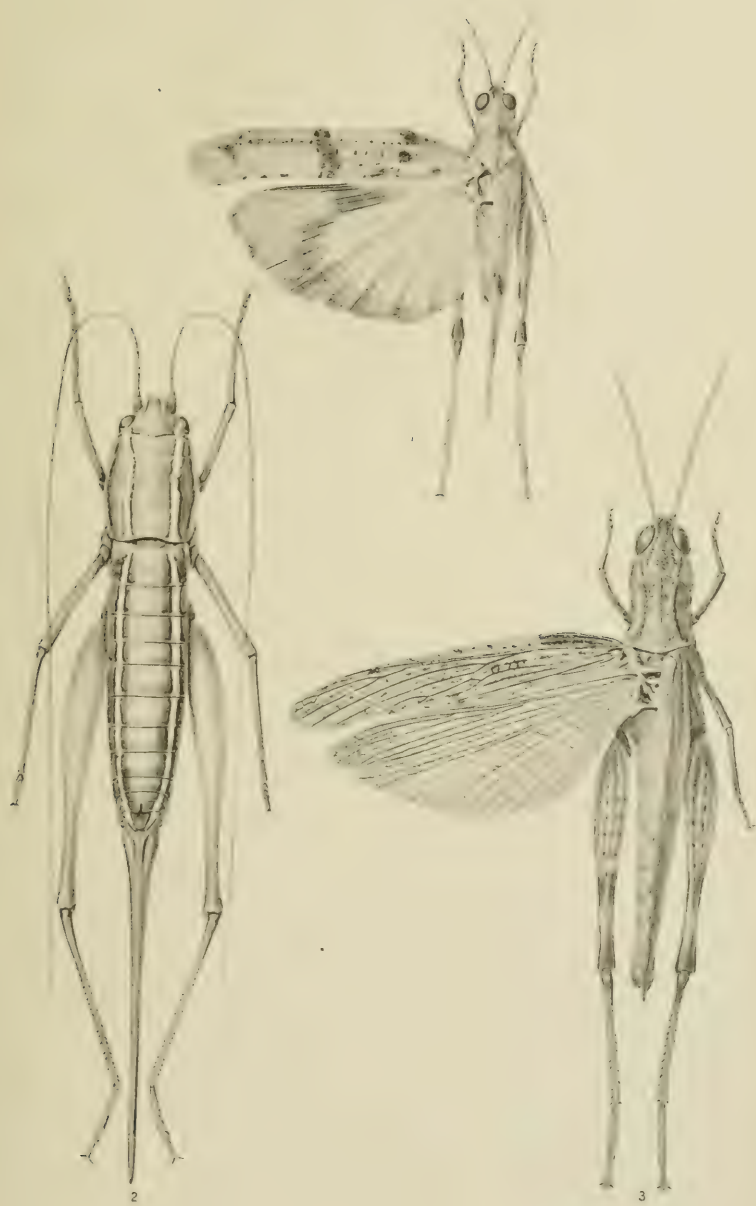


PLATE 4.

All the drawings are by J. Henry Blake, and are magnified two diameters.

- Fig. 1. *Dichopetala brevicauda*.
2. *Eremopedes popeana*.
3. *Ceuthophilus politus*.
4. *Ectatoderus borealis*.
5. *Arethæa carita*.



THE PUTNAM SCALE. (*Aspidiotus ancylus*, Putnam.)

BY T. D. A. COCKERELL.

The insect now known as the Putnam Scale is one of the most widespread and characteristic of North American Coccidæ. The first allusion to it in the literature of Entomology is believed to have appeared in Asa Fitch's *Third Report of the Noxious and other Insects of New York* (Trans. N. Y. Agricultural Society, 1856). On page 426 Fitch describes the Circular Bark-louse, *Aspidiotus circularis*, found on currant (*Ribes*) stalks at Albany, N. Y. The scale is said to be blackish-brown, with the centre pale yellow. Signoret, the French authority on Coccidæ, regarded this as a synonym of the European *Aspidiotus ostreæformis*, which it might very well be, so far as the description goes. However, Dr. Lintner found the genuine *A. ancylus* on black currant at Albany, and it is nearly certain that it was the same thing that Fitch had before him. Professor Comstock tried to settle the identity of Fitch's insect by examining his original type. But he found merely a fragment of a scale gummed to a card, and stated that "from this fragment it would be impossible to recognize the species." Under these circumstances, the name *Aspidiotus circularis* cannot be taken up, but must be cited as *probably* synonymous with *A. ancylus*.

The first undoubted reference to the scale under consideration was made by J. D. Putnam in *Transactions of the Iowa State Horticultural Society* for 1877, vol. xii, p. 321. It was here described as *Diaspis ancylus*; but the same author, in *Proc. Davenport Academy*, vol. ii, p. 346, gave it the name *Aspidiotus ancylus*, which is current to this day.

Prof. Comstock, in the *Report of the Commissioner of Agriculture* for 1880, p. 292, gave a full account of *Aspidiotus ancylus*, recording a variety, and adding to the original locality (Davenport, Iowa) two others,—Washington and Western New York. In the same volume, p. 360, Dr. L. O. Howard describes the parasite *Coccophagus varicornis*, which was subsequently stated by Comstock to have been bred from *A. ancylus*. This *Coccophagus varicornis* was subsequently made the

type of the genus *Physcus*, Howard. Dr. Howard in 1895 recorded another parasite of *Aspidiotus ancyclus*, namely *Prospalta aurantii* (Howard).

Comstock did not propose any popular name for *Aspidiotus ancyclus*, but the present writer (Bull. 19, New Mexico Exper. Station, 1896, p. 106) designated it Putnam's Scale, and the term "Putnam Scale" has now come into general use.

In 1896 (Tech. Bull. 6, Div. Ent., Dept. Agriculture) the present writer took *A. ancyclus* as the type of the subgenus *Diaspidiotus*, Berlese and Leonardi, a subgenus which includes a series of species living in the Holarctic Region, among them the dreaded San José Scale.

Owing to the invasion of the San José Scale (*Aspidiotus perniciosus*) in the Eastern States, this whole group of scales came to be studied anew, and Putnam's Scale became especially important because of its great similarity to the San José Scale, and its very general occurrence. Although perhaps commonest on maple, *A. ancyclus* was found to infest many kinds of trees, including various fruit trees. It was also found in many different localities; even, for example, in the mountains of New Mexico, at Pinos Altos. It apparently extends southward along the table land of Mexico, for specimens taken by Koebele on the bark of *Quercus engelmanni* at Amecameca, Mexico, May 25, 1897, appear to be nothing but *A. ancyclus*. In these Mexican specimens the circumgenital glands are as follows: posterior lateral groups, 6 to 7; anterior laterals, 10 to 11; median, 2.

The species undoubtedly varies in different parts of its wide range. One variety (var. *serratus*, Newell and Ckll.), found on willow at Ames, Iowa, has received a name. Another variety occurs at Ames on *Acer nigrum*. Mr. W. Newell has noticed that the variation of *A. ancyclus* on *Acer nigrum* "is enormous," whereas on other plants he found it very constant in the form of the lobes. A careful study of all these variations would no doubt yield results of much interest.

In 1899 Mr. W. Newell gave an account of another variety of *A. ancyclus*, for which he proposed the name *latilobis*. It was found on *Pyrus americana* at Ames, Iowa. (For full particulars see Contr. Dept. Zool. and Ent., No. 3, Iowa Agricultural College, p. 9.)

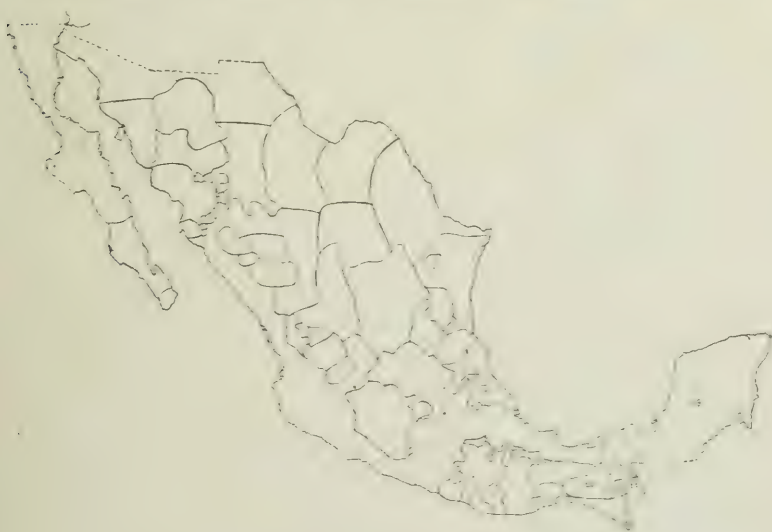
NOTES UPON THE ETHNOGRAPHY OF SOUTHERN MEXICO.

EXPEDITION OF 1901.

BY FREDERICK STARR.

In the preceding volume of the Proceedings of this Academy, the author has published notes made, regarding sixteen or seventeen tribes, during expeditions of 1898, 1899, and 1900. In the present paper he presents notes made, in 1901, among eight tribes—Aztecs, Huastecs, Mayas, Tehuantepecanos (Zapotecs), Zoques, Tzotzils, Tzendals, and Chols. On the accompanying outline map the areas occupied by these tribes are indicated, by numbers, as follows:

III., Aztecs. IX., Tehuantepecanos. 18, Huastecs. 19, Mayas. 20, Zoques. 21, Tzotzils. 22, Tzendals. 23, Chols.



THE AZTECS.

A few additional notes regarding the Aztecs are presented. They relate to Aztecs in the State of Puebla, those (Tlaxcaltecs) of Tlaxcala, and those of certain towns in Vera Cruz and Hidalgo. We have

already quite fully described *the Feast of the Dead*, as it is observed in Cholula and various Tlaxcalan towns. In November, 1900, two friends — Manuel Gonzales and Romualdo Quechol — secured, for me, a series of objects used in this celebration. The list is long, but, as I know of none that has been printed, I give it in full:

A.— OBJECTS OF POTTERY.

- (a) *Black ware*: made at Puebla; heavily coated with a brilliant, black, glaze. It is a particular favorite with the Indians of Huexotzinco, (Puebla) and San Martin (Tlaxcala), though it is also used in other villages.

hueycopalkaxistl, (great copal vessel) or *hueypopochkaxistl* (great smoke vessel); censer of large size and elaborate form. (Fig. 3.)
copalkaxistl (copal vessel) or *popochkaxistl* (smoke vessel); censer. (Fig. 3.)

pitchers, for holy water. (Fig. 3.) plates for dulces or sweet-meats; these dulces are made of *ayotl* (calabash) or a composition of *camotl* and *chillacayotl*.

small cups, bowls, etc. (Fig. 2.)

candlesticks. (Fig. 4.)

- (b) Glazed ware; black foundation with designs in red, pink, green, and gilt.

vases, pitchers, mugs, cups, plates, and censers of various sizes. (Figs. 3, 5.)

- (c) Coarse ware; coarsely painted in red, blue, and white.
 candlesticks.

- (d) Coarse, unglazed ware; crudely painted in red, yellow, and white. Both ware and pigments are of Indian manufacture. From the pueblo of Tlaxcalantzinco. (Puebla.)

censers. (Fig. 6.)

candlesticks. (Fig. 6.)

figurines of bulls (*totorotl*) and of human beings. (Figs. 7, 8, 9.)

B — BASKETRY, ETC.

large carrying basket.

variety of smaller baskets, boxes, goblets, bird-shaped rattles, and other toys of plaited palm, etc.

xochipetlatl (flower-mat), pretty mats with colored designs, upon which the offerings to the dead are spread. They are made, especially, at Tepexitl.

tepexomac (jicaras) or cups, bowls, and toys made of small gourds, brilliantly lacquered. From the State of Guerrero.

C.—COPAL, fragrant gum for incense; it is sold wrapped in corn husk. Cigarettes of tobacco, with bright wrappers.

D.—BREADS, of various kinds. These are all used by the Indians, though some of the varieties are also used by the *mestizo* population. The full page plate will show the forms: (Fig. 1.)

1.	2.	3.
4.	5.	6.7
8.	9.	10.

1. *pan totopo*: thin, hard, dark, sprinkled with white sugar, upon which are strewn red designs.

2. *pan tlacotonal*.

3. *pan liso*: round, plain, two-layered, breaking and cracking, in drying.

4. ; sugared, and red below.

5. *pan ichtl*: small, round, with a navel-like spot at top; made without shortening, and symbolizes purity.

6.

7. *pan de las animas*, bread of the souls: tongue- or flame-shaped; white and red.

8. 10. *ojoldres*: brown and glossy above; sprinkled with seeds.

9. *cocolochtl*: crisp; some are sugared and red below.

maimon: sponge cakes, varying in size, rectangular, sugared on top; are more sold to *mestizos* than to Indians.

While the plate gives a fair range, several favorites, as *pan tochtli*, *pan mail*, are not represented. Pan is the ordinary Spanish word for bread; *totopo*, *tlacotonal*, *ichtl* and *cololochtl* are Aztec.

The great washing basket—*hueytlapacchihuitl*—when used for the feast of the dead, should be new, never having been applied to any ordinary service. In it the purchases made for the dead are placed. Usually, separate portions are placed in it for each soul, and one portion is added for those souls that have no surviving friend to make provision for them. The *xochipetlatl*, with pretty colored designs, is made expressly for the occasion. When it has been laid upon the ground, flowers—particularly “the flower of the dead”—are sprinkled upon it, especially around the edges: the portions are then placed upon

it and the souls are called upon to partake. The corners are sprinkled with holy water, the "flower of the dead" being employed as an aspergill — The cigarettes for the dead are made and used at San Martin; they are not used near the city of Tlaxcala as there they say "the souls do not smoke." — At Cuauhtenco, Tepetlapa, and other small pueblos on the slopes of Popocatepetl, they believe that the souls cannot come to partake of the feast until a special mass has been said. There, too, the houses and yards are carefully swept, and so are the roads; dust-whirls and butterflies are watched for, as they are signs that the souls are coming. At this time of the feast of the dead, friends have the right to go to houses, where a death has occurred during the year, and to receive food and drink, after paying five or six cents. With the money thus secured a sheep is bought: it is decorated with ribbons, streamers of colored paper, etc., and taken to the grave of the dead man where it is left. Later the priest, or his representative, leads it away, and must say a mass in return for it. At San Martin Texmalupa, the money is spent for a load of wheat, which is left, in the same way, at the grave, for the cura.

Presumably in every part of the Aztec area stories would be found associated with the various places in the neighborhood. Among such stories, relative to localities near Santa Ana, are the following:

Manantial del Conejo (spring of the rabbit);—At the edge of the town is a fine spring of cool water. It is said that a man of the village was once in pursuit of a rabbit; the animal leaped into its burrow and the pursuer began to dig it out with a stick; he came, finally, upon—not the rabbit—but a fine spring of running water, which has remained until the present time.

Tepantzole (*Teopantzoltic*):—One day, from a cloudless sky, at half past ten in the morning, there was heard a fearful crash of thunder, such as accompanies the torrents from Malintzi. Rushing from their houses to see what had happened, the people saw a body of water, like a great lake, descending from that mountain. Of great depth, it advanced slowly, with a smooth and brilliant surface. It overwhelmed a church, carrying fragments of its walls to a considerable distance, where they are still to be seen. The sheet of water was called *tezahatl*, "water of evil augury" or "water of great depth." Before that time most of the many *barrancas*, or erosion gorges, of this district did not exist or were much smaller than now; they then assumed their present character.

Barrio de Tezcacoac;—in the ward of Tezcacoac there were formerly two gigantic *ahuchuetls* (cypresses). One day, in the middle of the afternoon, a thunder-crash was heard. All rushed out to see what had happened, believing that divine wrath thus punished some dreadful sin. One of the *ahuchuetls* had been struck by lightning and was smoking. At its base was a little fellow, entirely naked, save for a red band which diagonally girdled him; he was embracing the tree with both arms and hiding his face from sight. The people crowded around and the women, with kind words and blandishments, tried to attract his attention, but to no purpose. Suddenly, there came another crash of thunder and the *nawake* disappeared. The name *nawake* is generic and ancient; their faces must never be seen. It is suggested that the name comes from the verb *flanawatchis*, to embrace.

Barrio Cihuatcotla; Cihuatcome;—between Ixcotla and San Bernardino Contla. At this place young people are much given to night strolling. On such occasions they often hear noises in the *barranca*, as of women talking, laughing, singing, and quarreling. If one approaches cautiously he may see females, with garlands on their heads, disporting themselves in the water. They signal to the observer, who must refuse their advances.

Cuauhtlanpanca (split head, or divided head):—Malintzi was a beautiful woman; the neighboring mountain, a handsome youth, loved her, had offered himself in marriage, and had been accepted. Just then Popocatepetl, having lost his wife, Ixtaccihuatl, offered his hand and heart to Malintzi. She, true to her lover, refused; Popocatepetl, infuriated, hurled a mighty rock at his rival and split open his head. Cuauhtlanpanca, with his cleft head, may still be seen just to the north of Malintzi.

The Indians of many Aztec towns in the States of Puebla and Vera Cruz carry burdens in a contrivance which consists of two frames, filled with a network of leathern thongs, lashed together along the lower edge and free to separate above. Articles to be carried are placed in this, which is then borne upon the shoulders by the usual carrying straps. (Fig. 10.) The specimen figured is from Jonotla Puebla and was presented to me by Mr. W. S. Spencer.

In the *Huasteca veracruzana* are a number of prosperous Aztec towns. They are conservative and Aztec is the daily speech. We visited Tamalin. The houses at this town are well built. Several buildings are irregularly set in the yard, which is surrounded by stone

walls or neat fences of horizontal poles. Gateways are left in the fence, but are usually filled to a height of a foot or so with a guard of poles or sticks, set upright, side by side, and firmly lashed together.—The *teopantzinltl* has walls of poles carefully covered with a smooth coating of mud mixed with chopped straw. This is applied by hand and then smoothed with a simple wooden trowel—a rectangular block with a projecting ridge handle extending along the middle of the upper side the whole length of the block.—In the better class houses of this district—at Ozuluama, Tamalin, Tantima, etc.,—those of *mestizos* as well as Indians, the heavier timbers of the ceilings and walls are neatly covered with this mixture of mud and straw. The process is often so developed as to produce paneling, with squared or rounded edges. When whitened the effect is pleasing.—The roofs are composed of a thick thatching of palm, which projects well beyond and below the tops of the walls and is neatly trimmed straight and square at the bottom; this thatch is handsomely finished off, on the top, by a crest which rides the ridge closely and is firmly fastened down. The lower line of this cresting is the only break in the smooth, uniform slope of the roof.—Many houses have little window openings, near the top of the wall, which are usually barred, at intervals, with vertical poles or sticks (these are, frequently, poles used in the construction of the house walls, which have not been cut out in making the window). The upper line of the wall is not in contact with the roof, which has its independent supports.—The cook-house is less substantially built than the *teopantzinltl*, the walls often consisting of poles set vertically, side by side, without a mud coating.—The *temascal* (sweat-bath-house) here has a rectangular ground form; the walls are of upright poles set closely; a horizontal pole at a little less than half the height serves as a strengthener, to which the uprights are lashed; the roof is arched or vaulted and made of longitudinal poles lashed side by side. This construction is well coated with mud and chopped straw neatly smoothed. The floor is paved with irregular, flat stones of various sizes. An *olla* or two for water and a handful of leaves or herbs are usually to be seen within. In one of the back corners is an irregularly-shaped fireplace of stones with a slab covering the opening. A door of cedar closes the *temascal*. A cross, worked in the mud and straw material, is on the front wall over the door.—The old-fashioned weaving of cotton cloth occurs here, but rarely. A few *enaguas*, and even fewer *huipilis*, of native material are worn, chiefly by old women. Most of them are plain white, without decoration. One old

woman was seen with an *enagua* of native cloth decorated with black-embroidered designs. Such *enaguas* and the old-fashioned *quichiquemils* are worn by the *viejita* (old woman) in the dance of the *Viejos*. The ordinary *camisas*, made of purchased cotton cloth, are decorated at the neck and armholes with a band of heavy and coarse open-work in which geometrical, bird, and animal patterns occur. No *faja*, or belt, is worn, the waist-band of the skirt fastening tightly over the *camisa*. Little girls wear a single piece garment, a *camisa*, or *huipili*, with the open-work neck-band.—The variety of breads made of maize is astonishing. *Tortillas*, of course, are general: but there are



also *cocoles*, *chavacanes*, and *pemol*. *Cocoles* are flat, round, cakes of maize, about two inches across and three-eighths of an inch thick; they contain shortening and are served hot. *Chavacanes* are thin, flat, square, crisp crackers of flakey texture, made of corn meal, eggs, and shortening; they come hot from the griddle but are also eaten cold. *Pemol* is made in horse-collar-shaped cakes of some size; they contain sugar and shortening and are baked in an oven; they are crumbly in texture and sweet in taste.—In the markets of Tampico certain water vessels are sold which in form and decoration more nearly resemble the wares of the Pueblos of New Mexico and Arizona than any other Mexican pottery we have seen. There are two kinds of these.

The finer is a yellowish-gray or cream-colored ware with brown patterns; this is made at the Aztec town of Huejutla in the State of Hidalgo. The other ware is made into similar *ollas*, but is coarser, red in color, and with white decoration: it is made at Panuco. Both these wares are unglazed. The Huejutla ware is a favorite and is widely used in all the Aztec, Huastec and *mestizo* towns of this region. Besides *ollas* it is made into neat flasks or canteens and into flower-pots. The decorations on this ware are notably curious and conventionalized. (Figs. 11, 12, 13, 14; also accompanying cut.)

Danzas, or dances, are in vogue in these Aztec towns of the Huasteca. At Tamalin the annual *fiesta*, which lasts four days, begins on December 12th, the day of Our Lady of Guadalupe. At this time four dances are simultaneously in progress—*Santiago*, *El Gabilan*, *La Lagarta*, and *El Toro de cuero*. In November, at the time of the feast of the dead, they dance *Los Viejos*. At San Sebastian they have much the same dances, but their festival begins January 20th. At Tantima the *fiesta* is January 20th. As elsewhere, the feast of the dead, hereabouts, requires several days. Their names are:

conetzitzin: day of the little souls.

huchueyin: day of the adult souls.

tlatiochihualistli: day of commemoration of the dead.

In regard to some of these *danzas* a few additional words may be said:

Danza de Santiago.—This is really a dramatic performance with definite dialogue between Pilate and Santiago. This is in Aztec. Some twenty dancers take part; they are divided into two parties, which line up facing each other. Santiago is inside a framework representing a horse, the upper part of his body projecting above, as if he were riding the animal. He goes prancing back and forth between the two lines, followed by a little lad who represents his guardian angel. King Pilate is masked and walks back and forth behind the two lines. He attempts to attack the Saint and they exchange blows whenever possible. All the other players try to prevent these battles and to protect Santiago. Each of these players wears a band around his head to which a sort of bonnet is attached. Two musicians, with aboriginal instruments, furnish music, which is special to the occasion. One plays the *pito*, (Fig. 15b) a cane pipe with blow hole and five holes for the escape of air, one of which is below, four above. The other beats upon the *huchuetl*, a wooden cylinder with a piece of peccary skin stretched across one end. (Fig. 16.) The music is simple. With some difficulty we secured part of the Aztec text of this little play. It

is a portion of the dialogue of the *escribano*, scribe, or secretary. The person repeating this said that his father used always to play the part of the *escribano*, and that he himself formerly had all the parts written out but had lost them. He declares that it will be but a little time before the dance will here be without words, as it already is at some places.

El Toro de cuero (The leather bull).—In this *danza* a bull fight is represented. The bull is represented by a man within a light framework covered with leather. Two *toreadores*, two *picadores*, and at least ten others participate. A *pito* and a *tambour* (drum) furnish music. The *pito* is quite different from that used in the *Santiago*. The cane is longer, has but four escape holes and the mouthpiece is different, consisting of a small tube set in a mass of black gum. (Fig. 15a.) Four different pieces are played during the *danza*. The first is loud and shrill and is played at the beginning when the village saint is carried in procession; the second, played during the greater part of the dancing, is monotonous, consisting chiefly of the repetition of two shrill notes, with a succession of three notes differently arranged, inserted here and there; the third and fourth are more varied, though consisting of but few combinations, with much repetition. These four pieces have their individual names:

- (a) *tlalyuwalulixtli*—the first.
- (b) *kiawititi*.
- (c) *kitlayitisi*—when preparing to kill the bull.
- (d) *kimiktisi*—when the bull is dying.

Los Negros (the negroes).—There are two players, *Negro* (negro) and *Pañol* (Spaniard.) They wear suitable wooden masks, painted, and supplied with coarse fibre, for hair. This is an exceedingly lively dance, with vociferous Spanish dialogue. The two players often speak at once. Small rattles made of cow's horns are used and are hung, by a loop of cord, from the wrist. Each player also carries a wooden gun over his left arm. (Figs. 17, 18.)

Los Viejos (the old ones).—Takes place at the time of *Todos Santos* (All Saints). Bands of three players go from door to door, through the streets, begging. They are called *el viejo* (the old man), *la viejita* (the old woman), and *el mozo* (the servant). *El viejo* wears only an *ayatl* (carrying cloth); the old woman wears an *enagua* and a *quichi-quemil*, the dress of the olden time (Figs. 20, 21); the servant is naked and carries a gourd vessel for receiving donations. All wear small and

simple masks of leather (Fig. 19), that of the old man being bearded with *ixtli* fibre. They sing a song, in Aztec words, in which they state that they have come from afar to visit the *pueblo* and see how their descendants fare.

At Chontla they have as dances the *Montezuma*, *la Chenchera*, and *los Gabilanes*. The *chenchera* is also danced at Tantima. It has been described to us as follows: A pole is erected, in which some holes are excavated; several sticks are set and mats (*petates*) are stretched in such a way as to enclose, and presumably to conceal, a man within, who by means of cords manipulates various animal figures. First three woodpeckers (*chencheras*)—one large, the next medium, and the third small—follow each other up the pole, pecking, as they go, at the holes, in a life-like manner. At the top of the pole is an apple of paper, which opens. Men outside the enclosure try, by means of cries, shouts, and shooting of arrows, to scare the birds and drive them away from the fruit. A *mapachtl* (badger) also makes the ascent. Next a squirrel, with many rapid movements and turns, does the same. Finally a snake crawls up the pole, engages in a battle with the squirrel, and having conquered, begins to devour it. The people have constantly been attacking, with arrows and wooden swords, but at this point strike the snake down and rush upon it to despatch it.

The local priest at Tantima has a short vocabulary of Aztec, written down by an Indian boy at Citlaltepec. It is badly spelled but we print it as it stands to show the local dialect. (Appendix I.)

THE HUAXTECS.

The land of the Huastecs, the modern *Huasteca* and the ancient *Huastecapan*, is today divided into the *Huasteca potosina* (in the State of San Luis Potosí) and the *Huasteca veracruziana* (in the State of Vera Cruz). Orozco y Berra, in his *Geografía de las lenguas de México*, names ten towns in the former, eighteen in the latter region, where Huastec was spoken. The area of the tribe was formerly continuous and more extensive, as is shown by the evidence of geographical names. Names of places beginning with *tam* or *tan* in this part of Mexico are almost invariably Huastecan and indicate ancient locations of the tribe.

The *huasteco*, *cuasteco*, *guasteco*, is a language of the great Mayan family and the isolated occurrence, so far to the northward, of an offshoot of that southern stock is interesting. The language has been

considerably studied; in 1767, Cárlos Tapia Zenteno published a *Gramatica*; in 1890, Marcelo Alejandro published his *Cartilla Huasteca*, printed by the Mexican government; and in 1896, Serapio Lorenzano's little *Interprete Huasteco* was also printed by the government. Marcelo Alejandro, a pure Indian of Huastec blood, lived at Ozuluama when we passed through there in January, and had just completed his seventy-fourth year.

The ancient Huastecs were reputed good warriors. Orozco y Berra says: "they formed a semi-barbarous and valiant population, which knew how to defend its independence against the kings of Tetzcoco and against the emperors of Mexico: the arms of the latter penetrated into their (Huastec) territory as proved by the hieroglyphic annals; but the invasion was transitory and not converted into a conquest." The ancient Huastecan culture was peculiarly interesting, but it has been little investigated.—The present condition of the Huastecs is curious and, in a degree, painful. They and their language are losing ground. Of the *Huasteca potosina*, we can say nothing from personal observation. In the *Huasteca veracruzana*, people and language are yielding, not only to the *mestizos*, which might be expected, but also before the Aztec. In their old home the name of Huastec is almost a by-word and their language is scorned while the "noble Mexicano" (Aztec) is held worthy of cultivation. To know Aztec is almost a necessity, while to know Huastec is almost a disgrace, outside of a few purely Huastec towns. In 1864 Orozco y Berra listed eighteen Huastec towns in the *Huasteca veracruzana*, of which twelve were in the district of Tampico and six in the district of Tuxpan. Of the latter we know nothing: of the former Pueblo viejo, Ozuluama, Tantima, and Chontla cannot be called Huastec towns. Pueblo viejo and Ozuluama are *mestizo* towns with Spanish speech: Tantima contains many *mestizos* and its Indians are Aztecs. In Chontla there are three divisions of the population, occupying distinct sections of the town: the portion at the foot of the mountain is divided between the *gente de razon* (*mestizos*) and Huastecs; the third section, on the slope, is occupied by *arrieros*, presumably Aztecs and Aztec *mestizos*. The three industries of Chontla are maize, cattle, and wax. There is considerable trade in the latter and bees are regularly hived.—In Orozco's list we find *Congregacion de Tamalin*. So far as we could learn the whole village of Tamalin is Aztec. We are inclined to identify this *congregacion* with the little village of *Gutierrez Zamora*, less than a league from Tamalin, on the road to Ozuluama. This town is truly Huax-

tecan, though a few Aztec families live together on its border.—The only really Huastecan town we visited was Tancoco, in the district of Tuxpan. The town is upon a crest, from which one looks over a sea of green forest, from which hill islands rise here and there. The houses are not characteristic. Somewhat like those of Tamalin, they are less carefully built and less neatly thatched. (Sup. Pl. xlii.) Yet the town is notably clean and well kept and there is an air of general comfort. Men and women dress in *mestizo* dress; all wear good shoes; there is a resident tailor, of Huastec blood. In all the houses there are petroleum lamps and, in most, sewing machines. A town clock strikes the hours. There is a village band with European instruments. We saw no aboriginal musical instruments. If they have characteristic *danzas* we failed to discover them. They dance the Santiago dance, but with Aztec dialogue. They explain this by stating that the dance was introduced among them by an Aztec *congregacion* of their municipality. They dance *los Negros*, using Spanish words. They dance the *Monarca* and in it use a rattle made from the shell of a fruit, which is decorated with feathers.—In disposition the people appear gentle and timid; curiously interested in our work, they touched nothing belonging to us; they never entered our house without asking permission; they were remarkably respectful to their officials; there was no disorder, even in cases of drunkenness.—The physical type is well defined; it is characterised by notable flattening of the head behind, flat and broad face, thick lips, and oblique eyes. (Sup. Pl. xliii, xlv.) — Although all speak the native tongue they are forgetting many words. Numerals beyond sixty or seventy were recalled with difficulty, Spanish or Aztec words coming more naturally to mind. Some strange mongrels occur; thus, for four hundred, for which there should have been one simple word, we could get only *checcientos*—*che* (Huast. four) and *cientos* (Spanish hundreds). My informant suggested that perhaps some old person might know how to say it.—Weaving palm hats is a considerable industry. Quantities of palm are laid out to dry upon the roof or on the ground in front of houses. Both sexes, and all ages, braid palm as they walk on the street or sit in their doorway. Some of the work is rarely fine and delicate and the best grades are made by women.

THE MAYAS.

We need say nothing of the ancient Mayas. The ruins of their cities have been explored, described, and pictured for more than half a century: their manuscripts and inscriptions have baffled scores of

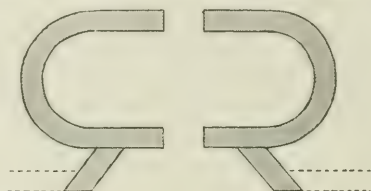
students. Their culture was one of the most interesting and perhaps the most advanced of the native cultures of North America. The Mayas still live and today form the mass of the population of Yucatan. Writers have already emphasized the vitality of the Maya language; it has not only continued to exist in the presence of the intruding Spanish; it has forced itself upon the Spanish invaders. We saw too little of Yucatan to make dogmatic assertions, but we believe that the language still holds its own and that even the Indian blood is gaining ground.

The Maya is the type language of a well defined linguistic family, which occupies parts of the States of Vera Cruz, Tabasco and Chiapas, a large part of the Republic of Guatemala and a portion of Honduras. About thirty languages are included in the family. In Southern Mexico, besides the Huasteco, already mentioned, the Tzendal, Tzotzil, Chol, Chaneabal, Punctunc, Chontal, and Mam, are languages or dialects of this family. The Lacandons speak Maya. Some authors connect the Totonaco with the Huasteco.

In character, the Maya Indian is conservative and suspicious. In Yucatan the *mestizos* have a proverb, *El indio nació robando—y muere dudando*: "the Indian is born a robber and dies a doubter."—The physical type is more varied than we had anticipated. The color varies considerably but, on the whole, is dark; the head is rarely flattened behind; it is clearly brachycephalic; the face is frequently broad and round, with a curiously retreating chin; the nose is often aquiline, but is low rather than high.—It is matter of common belief among *mestizos* that every pure-blooded Maya has a violet or purple spot on the back at the vertex coccygeus: this is called the *uits* (bread) and it is a common insult to refer to it—e. g. to say "*ūā^h hā uits*."—The common attitude of rest is a squat position, with the knees slightly forward and the hams resting upon the thighs, the weight being thrown upon the balls of the soles of the feet.—All travelers mention the fastidious neatness of the Mayas. Both body and dress are kept scrupulously clean. Personally, we doubt whether this is completely praiseworthy, suspecting that it stands in relation to the survival of certain ancient vices; our observations permit no definite statement, however.

Houses in Maya towns, and many of those in the city of Merida itself, are peculiar. The ground form is elliptical, the long axis being transverse; there are often two doors, opposite each other, at the ends of the short axis. The base of the house is built of stones, often slabs set on edge; the walls rising from the base are thinner than it, so that the basal part projects somewhat. The walls may be of poles and sticks

daubed with mud, or they may be constructed of stones of irregular form closely set with mud; the roofs are of thatch. (Sup. Pl. xlvii.) Often two such houses stand together, one directly in front of the other; when this is so the house in front has two doors as described, while the other may have but one. The front house of such a pair is the more carefully built. It may have the walls firm and substantial, smoothed and neatly plastered, while the rear house may be badly constructed, with the walls irregularly and incompletely mud-daubed. Quite a characteristic feature of the Maya house is the guarding of the sides of



the front doorway by two well-built walls, reaching obliquely outward. These are frequently as high as the doorway itself and may be neatly plastered. Properly, they are continued into the fencing wall of the yard about the house; they have, however, become so normal a feature of construction that they are often built even when there is no fencing wall for them to merge into.

Fire is still made, when matches or flint and steel are lacking, by friction of two pieces of wood. A piece of *ɔ.k.* (*canul*) is taken for the lower piece and a stick of some hard wood for the upright; the latter is whirled between the hands, its lower pointed end being set in a notch in a piece of *ɔaka*.— Among the chief articles of food are *pipian*, *frijoles*, *posole*, and *atole*.— A method of cooking, similar to the Polynesian oven, is not uncommon; it is *de rigueur* in the “milpa mass” and at the *chächik*. Both the oven itself and the food cooked therein are called *pib*.

Men wear low-crowned, broad-brimmed palm hats; trousers of white cotton, not so loose as is common among Indians further north; the shirt is neatly made, often pleated, sometimes starched, but it is worn outside the trousers; men working at railroad stations, or other places involving the handling of dirty burdens, wear an apron of ticking, wrapped tightly around the body over the clothing. Women wear two ample white garments, both hanging from the neck; the lower, longer, reaches to the ankles; the other is a *huipil*, reaching quite to the knees; neither is confined at the waist by a belt. These garments

are bordered at the neck and arm-holes with colored or black ornamental patterns and may be fringed with lace. These bordering patterns were formerly done in needlework; at present they usually are strips of white cotton stamped with red, blue, green, yellow, purple or black designs, which are sewed to the garments. (Fig. 22.) This style of dress is not peculiar to Indian women but is also worn by many *mestizo* women.— Women generally wear a medal or cross of gold hanging from a long necklace or rosary which may be spaced with gold coins. The money value of these ornaments must often amount to several hundred pesos.— The women tend to grow stout with years, and as they tread with a highly independent air, a middle-aged, well-dressed woman presents a notable picture.— Young women do up the hair at the back of the head in a large, projecting knot, which is quite characteristic. (Sup. Pl. li.)

Warm water bathing is general. There appear to be no *temascales* and no bath-tubs; the water is heated in an *olla* by dropping into it a heated stone of considerable size. This is handled with two sticks.— *Añil* (indigo) has special virtue and a cross of it marked upon the forehead protects the person against *aire*, (the air) which here, as in central Mexico, is held responsible for a long list of diseases.— When cattle are troubled with *peste*, four of the best *toros* are killed and buried in pits at the corners of their enclosure. When *sarampion* (measles) appears, they believe it to be a child, amused and pleased with childish things, so they set food and toys by the door that it may stop to play and eat and thus fail to enter. For *viruela* (smallpox) they prepare *susaca* (maize soaked, but without lye, and carefully ground), fill *jicaras* with it and place them at the caves, where the disease will partake and depart without harm. When a person has smallpox he takes scabs from himself and pricks them into others of the household, thus spreading the disease; the purpose of this appears uncertain.— The heart of a *golondrina* (swallow), burned and powdered, is a potent love-charm: it must be sprinkled on the hair of the person whose love is to be secured. The heart, plucked from a living *golondrina*, eaten raw, cures epilepsy.— *Santigual*: when a child is ill, the parents may send for a conjuror. After examining the patient, if he decides that it can be cured, he calls for a *jicara* and a candle. The candle is placed at the head, the *jicara* at the feet of the patient; all others withdraw; the conjuror mutters incantations and makes passes over the body, including the form of the cross. He then delivers the child, cured of his disease, which was due to *aire*.— *Chechem*: a certain tree which, at

night, becomes damp with dew; if drops of this fall upon a white man it causes irritation and swelling; upon an Indian they produce no effect. *Avispas* (wasps) also regard the Indian; whereas they swarm out to attack a white man, an Indian may handle them with impunity.—When a man has been given up to die, neither water nor food is given to him. Señor Don Manuel Sosa Romero, to whom I am indebted for much information regarding the Mayas, tells of one case occurring within his own experience. He knew a well-to-do Maya who owned land, a good house, many cattle, much maize, etc. He had three children and owned the houses in which they lived. All was going well when Don Manuel and another official were summoned to hear the Indian's "last words." Arrived at his house, they found the man sitting in his hammock, awaiting them, apparently in perfect health. He told them he had summoned them to hear his last wishes. Though agreeing that a man in sound health had a *right* to make his will, they remonstrated with him; in vain they argued; he insisted that he was about to die: he had had his *tinaita* (dream). He gave to one child a house, animals, corn, poultry; to the second his share; to the third likewise. Then he laid himself down in his hammock, took no food or drink, spoke to no one, and in six days was dead. Such cases of self-destruction are said not to be rare.—When a person dies the neighbors go to the house to mourn; should one of these mourners die, not long after, flowers are sent to the first deceased, by him. If it be the bereaved father who gives the flowers he says: *cin kubentic ti tech nicta utial a pati in luxmeyen*; if the mother, *utial pati ual quen kuchquetch tux*.—At the feast of the dead, October 31 is the time for the child souls; the food for them is prepared without *chili*; a table is adorned and spread; a *santito* (saint) is placed upon it; sweetmeats and other things which a child loves are set out; there is a candle and a special portion of food for each dead child of the family; no one touches any of the food until after the *rosario* (evening prayer) shows that the little souls have had their chance: the door is opened for their entrance. On November 1st the adult souls eat; their food is seasoned with *chili*; individual preferences are considered—thus *aguardiente* may be placed for a man addicted to drink, chocolate for one known to be fond of it, etc. On neither of these two days do hunters take the field, fearing that the soul of some friend may be in the animal hunted. On November 2nd, after mass, chocolate is set out as a final offering to start the souls on their way. The feast of the dead is called *chanalpiham*.—Ghosts return, often in dreams. Often a man will say: *tinaika*

axbe utanken upiñan i mama: yala tene xaiem boti' hunpel misa; yokol upiñan xakim boté—"I dreamed last night that my mother's spirit came and asked a mass of me: I go to arrange for a mass."—*Xtabay* is a form, which the evil one may assume to lure people to their destruction: it may be male or female. As a female it is usually a beautiful lady in white, with her lowered hair falling down upon her shoulders; she is most likely to be seen at night under large and spreading trees. She asks the passer whither he goes; suggests a ramble; even forcibly siezes and drags him to the edge of a precipice or cavern, over which, or into which, he is hurled. The heart of the victim is then torn out. —A lover gives his sweetheart a present called *muhul*: it consists of definite articles in fixed quantity—a pound of cacao, two reales' worth of wheaten bread, four pounds of sugar, three centavos' worth of salt, two reales' worth of soap, one pound of starch, one real's worth of indigo, six centavos' worth of black pepper, one pound of leaf tobacco, a flask of anisette. All of these articles are placed in a basket of special form called *abujo*. If the gift is accepted the girl is bound to marry the sender.—At the wedding feast the bride and groom sit at the head of the table. His god-father sits next to the groom: her god-mother sits next to the bride. The god-father dips a morsel of food into sauce and offers it to the groom; the god-mother dips one and offers it to the bride; the bride and groom then exchange the same courtesy: the guests then fall to eating.—The *tunkul*, or native drum, corresponds to the Aztec *teponastli*: it has largely gone out of use, but is said to still figure at some village festivals; the *caracol*, or shell trumpet, is used in rural places to summon the people: rattles for dances are made from a calabash-like fruit in which the dry seeds serve to give the noise; horns of cattle with a sort of mouth-piece set with wax are sometimes used as trumpets; a small bow, or arch, made from a *bejuco* (vine), strung with a cord, is held with the cord to the mouth; air is breathed upon it and it is caused to vibrate by being struck with a small stick. This instrument is called *jul*.—At an eclipse of the sun or moon, they believe that a creature, named *baboal*, is devouring the luminary and make a great din to scare it; a pregnant woman must not touch any part of her body with her hand during an eclipse, lest she injure that part of the babe, which is to be born.—*Camalonga*: there is sold in the portales of Merida, and at other towns generally, what is called *camalonga*. This is an irregularly round object, dark in color, looking somewhat like a pebble; it is perforated and strung upon a bit of cord: it is said to be an imported root. It is

dipped into water, which is then taken internally as a remedy; it may be dipped into *anissette*, and the liquor is then applied as an external wash. A *camalonga* may also be carried upon the person, worn at the neck or the wrist. Such an object is often put in a little capsule of gold or silver and tied at the wrist of a child, to protect it against convulsions.—*K'esh* are sold everywhere. They are little human figures of silver or gold: they are votive offerings, but the name means "an exchange," "to exchange," and in describing their use this idea of exchange, or substitution, is clearly brought out:—"if a man is sick and near to death, he gives the *santito* one of these in exchange for himself." (Fig. 23.) Among the votives and gifts to saints in the churches are clusters of pretty little orange-yellow gourd-like fruits, called *chuchitos*; this Spanish word, derived undoubtedly from *chichi*, a woman's breast, is given on account of the form. Father Juan Blanco, cura at Tekax, to whom I am indebted for much information, says that they are not edible, and that they are used only as toys for children and gifts to saints. Personally, we believe that their name and form indicate some special significance as gifts to saints.

The *Kubpal*, (*entrega de cabeza de cerdo*, carrying the pig's head), is celebrated on the third of May. One Indian serves as *hermano mayor*, older brother; he invites the *hermanos menores*, younger brothers. Each contributes a *rueda*, wheel. At the centre of each of these is fastened a living bird or reptile. A *ramada*, leafy bower, is prepared beforehand. In it the various *ruedas* are suspended. A carrier leads the line bearing the *rueda* of the *hermano mayor*, which consists of a great loaf of bread, of wheat flour, set around its circumference with *pesos*. The *hermano mayor* bears an entire, cooked, pig's head. All dance to music. After the dance all partake of the feast which is set out on a table in the *ramada*.—The *xtoles*, formerly danced every carnival season in Merida, is falling into disuse. Still, we saw a band of these dancers in 1901. They are Indians, or are intended to represent them. Their dress is peculiar, characteristic, and, in part at least, survival. In the company we saw there were fourteen dancers and a standard-bearer; of the dancers seven represented females and wore the usual female garments and necklaces of coral beads, gold chains, pendants, etc.; their breasts were indicated as exaggeratedly developed. The other dancers wore the usual men's white shirts and drawers, but the latter had a red stripe down the side of the leg; jingling hawkbells were hung to various parts of the dress;

red *fajas* (belts), were worn about the waist. Most of the dancers wore sandals. All wore crowns, consisting of a circlet of tin, from which rose two curving strips of tin, which crossed above the middle of the head; from this circlet at spaced intervals rose four feathers — either real feathers or imitations in tin; two of these crowns, with real feathers and of unusual magnificence, denote the king and the queen. Under these crowns, covering the top of the head and hanging down behind over the shoulders and back, were gay red and blue kerchiefs. All were masked, mostly with old bits of brown cloth, with eye perforations and with nose and chin pinched up and developed by tying. The men wore a baldric, or bandolier, which was probably of ancient type. It was wide, square at the ends, made of cotton, with inwoven designs — geometrical, animal, bird, etc. — in colors; at the ends hung bivalve shells. (Fig. 27.) The rattles used had an oval body set into a conical bunch of splints, uniting downward into a handle; these rattles were painted gaily. (Fig. 24.) Fans were carried by some of the dancers; they had a wooden frame and handle, decorated with the national colors; the body was made of the handsome feathers of the ocellated turkey; the handle is made of a turkey's leg. (Fig. 26.) There were two musicians, one with a *pito*, or whistle, with a small mouthpiece gummed at the end of a long tin tube pierced with note holes; the other carried a painted tin drum of the *huchuetl* type; this he played with his hands. Hung to the side of the drum, near the top, was a turtle-shell upon which the drummer struck with a deer's horn. (Fig. 25.) The standard consisted of a long pole, surmounted by a tin disk, representing the sun's face with a protruding tongue; on the cotton banner were painted the sun, two men dancing, a serpent, and the words *Suburbio de Santiago, 1900*. The leader of the dance, the queen, carried a cord of San Francisco, with which to strike unskillful performers and intruders. Besides their own musicians, they had an accompanying band, which played music like their own; it played before and after the dancing and when the company passed from house to house. During the dance itself the *pitero* and drummer perform. The music was peculiar and may be both old and Indian. The words sung were Mayan. Signals were given by the *pito* — *one*, music; *two*, prepare; *three* and *four*, dance; *five*, stand. At the beginning of the dance, the king, queen and two musicians were in the centre, the dancers circling around them in a double circle; they then formed into two files, facing, alternately, men and women; salutes were given and pairs danced;

a man danced, first with one, then with the other, of his immediate neighbors. There was a good deal of indecent suggestion in the dance. The fans and rattles were used in graceful movements among which crossings were frequent. After the dancing there was a good deal of rough and extravagant pretense of love making between the fictitious couples. The American Consul, Edward H. Thompson, has made a careful study of this curious dance, taking phonograph records of the music and cinematograph pictures of the movements. We understand that he considers it ancient and aboriginal and claims that it is represented in the mural paintings of ancient ruins. — At carnival time we saw, at Progreso, a band of *mestizo* dancers who gave a pretty dance with *palitos*, or staves; they had a standard, music, and leader, and were wonderfully trained. Their songs were in Spanish. The movements were almost exactly the same as those of the *Xtoles*, and the leader insisted that the music was the same, that of the *Xtoles*, being translated from that of the *Palitos*. A careful comparison would decide which is the original, and which the copy, if they are really related. — At the *Museo Yucateco* in Merida, we photographed three old wooden masks which were “worn by Indians at Carnival;” they were well carved. One is believed to represent the conqueror, Montejo; it has been painted white and has a long beard; the second is also bearded, has hair gummed on, and likewise shows signs of white paint; the third is smaller, is whitened, but has no beard. (Fig. 28.) — In the same museum, there is a board, nearly four feet long and one foot five inches wide, which bears in high relief figures said to have been carved by Indians; the date is uncertain, but the piece appears quite old. A rural scene is represented; an Indian, squat behind a well, is drinking; three birds are at a tank of water; behind this is an Indian carrying a basket of bottles. (Fig. 29.)

The *h'men* is the medicine man, the conjuror, the oracle, among the Mayas and he still plies his trade briskly. He says the “milpa mass,” performs witch-craft, consults crystals. Don Manuel says that a good many years ago a *h'men* was offered some trifling sum for his services; he was greatly offended and said that any *cura*, or priest, would repeat mass for a peso-and-a-half, but that *he* must have five pesos. This having been reported to the parish priest, he made a charge against the old man, who was cited to appear before a joint commission, ecclesiastical and judicial, at Valladolid. At its order the old man went through with his performance, erecting his platform, repeating his formulæ, and making his symbolic movements. The

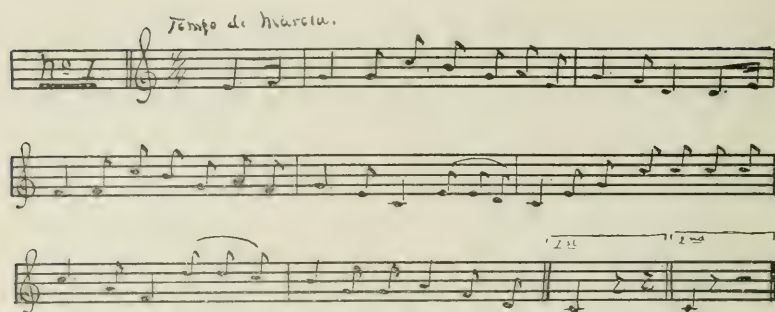
commission decided that he was merely repeating mass in Maya and let him go.—At harvest the *h'men* performs *tich*. A platform is erected upon four poles or posts, and a cross is set upon it. A hole is dug and lined with stones and a fire is built therein; bread is prepared, and large cakes, which are wrapped in leaves and baked in this oven; *balche*, a special drink, fermented bark of the balche tree mixed with honey, is prepared. This *pib* and *balche* are the bread and wine of his mass. With the liquid he sprinkles the four winds and invokes them and the wells for leagues around: the largest and thickest loaf of bread is then treated as the wafer in the Christian mass. Two assistants participate in the ceremonial.—*Chächäk* is the corresponding ceremony at seedtime.—The *h'men* makes much use of *sastun*, the magic crystal. Of such, he frequently has six or eight, the smallest of which he calls by the same term of endearment that is applied to the youngest of a family of children. These precious objects are usually glass stoppers from bottles or bits of prisms from chandeliers. Into them he gazes for visions.—Don Manuel states that in the town where he formerly lived, there was a *h'men* who was his *compadre*. On one occasion a boy sickened and his father, suspecting that the *h'men* had bewitched him, went to the Judge (Don Manuel). The *h'men*, summoned and questioned, replied: "No, *compadre*, it was not I, but I can discover who it was." Calling for a candle, salt, *aguardiente*, and cigarettes, he withdrew with the judge. After drinking and smoking, he lighted the candle and held his *sastun* between his eye and the flame: no result. Near midnight he tried again; still no vision. At the third trial, at daybreak, he saw the witch and described his location. He offered to transfer the bewitchment from the boy to the witch, but the boy's father feared consequences; on inquiry, he found that the accused really was at the place indicated at the time of the vision. This added to his fears, which became terror, when he saw the *h'men* cautiously burying something near his house. Hurrying to the judge he communicated his suspicions. The *h'men* was again summoned and ordered to dig up what he had buried. On refusing, he was beaten. Finally he yielded and dug up a little figure of black wax, representing the witch upon whom he wished to turn the force of his own conjuration.—It is said that the Indians foretell the weather for the year by observation of the days in January. The days from the first to the twelfth give the weather for the corresponding months; those from the thirteenth to the twenty-fourth, taken in inverse order, modify or verify the observations. Thus the thirteenth gives the ver-

ification for December, the fourteenth for November, and so on. The portions of the day give the prediction for the part of the month corresponding to them in position. To us, this seems doubtfully of Indian origin.

THE ZAPOTEC OF TEHUANTEPEC.

For general statements regarding these we may refer the reader to the preceding series of *Notes*. We have but few additional matters to offer. The Zapotec town of Huilotepec, a few leagues from Tehuantepec, possesses a well-preserved, ancient "Mapa," painted on a strip of coarse, native, cotton cloth, 1.555 by .540 m. Three colors are used in the painting—blue, red, and black. All are somewhat faded. Mountains and hills, sea, river, and lagoons are in blue; red is used for division and enclosure lines; black outlines kings, horses, church, tiger, shield, two roads, etc. The two upper rulers wear pink capes; the third is in pink garments, the fourth wears a crown and garments of pink; all sit on black seats. In the group of eleven persons below, or at the side, of these four, the mid one in the second line has a blue cape; the first and third of the lower line sit on pink seats; two individuals near them are darkened, as if with a wash of india ink. The serrate base of the mountains near the sea is black. In front of the two figures, which are included in the triangular space between the road, river, and sea, are three designs in pale blue; in the space above are two faint designs; in the other space near the nopal mountain is a device in the same faded color, on either side of the black houses. In the section with the shield there is a faint bluish design in the lower corner, in the road behind the figure and the house. Between the lagoon and the edge of the cloth is a pale blue design, probably a little hill, though it resembles, somewhat, a face; this has a word upon it in black, and a dull, irregular line runs from it to the left, toward the next division line. Some of the inscribed names look as if done in mirror-writing. It is the author's intention to publish a reproduction of this *Mapa* in the same style as the *Mapa de Huautla*, which he has already issued. It is for this reason that so much detail is given in the preceding description.—— Dr. Castle, at Tehuantepec, called our attention to Zapotec songs. Of these, he says, the *Zandunga* is a particular favorite. He believes that this was written after the historic events of La Noria and in connection with the outbreak. He says that it is particularly used at wedding celebrations, which are here elaborate affairs, running through a period of two weeks, during which the fam-

ilies of the two contracting parties try to outdo each other in entertainment. He asserts that when the Zandunga is being played in a house any passer-by, even the poorest Indian, may enter and participate in the festivities: he may even invite any lady present to dance with him and she may not refuse. A song which bears this name is reproduced below, but we see no connection between it and La Noria. — Attention once turned to these songs, we arranged with our friend, Don Arcadio G. Molina, himself a Zapotec, to assist us in securing examples of them. We are able to present sixteen, including the *Zandunga*. We are assured by a musician friend that the music has been profoundly influenced by European music. The words are given in Zapotec, with an English translation: the latter is made from Molina's Spanish translations, which will be found in the foot notes. — The music has been written by Luis B. Lopez, a native Zapotec band-leader. — So far as we know these are the first of these songs to be printed. In their words—a strange mixture of Zapotec and Spanish—in their poetical form, and in their content, they present interesting points for consideration. Molina says that there are three accent marks—first: ', suave or gentle when on the first, strong on the penultimate syllable; second, ^, gentle, affecting the penultimate or antepenult; third, ^, is strong. The letters xh=g in gentlemen; h is pronounced "slippingly," with the tongue against the palate; x=the English z.

*Soledad.*

Qué ganá shi modo racalaxhu!

Má xelu ñacadespedirla;

Napalu naha callate por lihi:

Adios! ingrata xaguisheluní.

I do not know what ails you!

You leave me without saying—Adieu!

I am dying here for thy love

Adieu! ingrate, thou shalt pay for it.

Nahatih más triste que guira.

Naxbiehé tuh que guixihí naha;

Guéla rirah ni pah lado chaha:

Sacá ngá guenda ranashihí.

I am the most unfortunate being.

I love, but without return.

I come at dawn, rambling,

Well I know what it is to love.

Ni rah lixhu que gandáchahá;

Bini lixhu rulaga naha

Xandá gapá alivio sacá lá?

Lihi namí que xandani; nja?

I may not visit at thy house,

For thy people despise me:

Can I live thus?

In truth, no.

Rúna, runa, sin cesar por lihi;

Cadi ngá ribexa de lihi;

Pero ma nuhú buena, guyeh,

Que xandaha quixhelaluní.

I live, ever sighing for thee.
 This I did not expect from you.
 But enough, enough,
 Thou shalt pay for it.

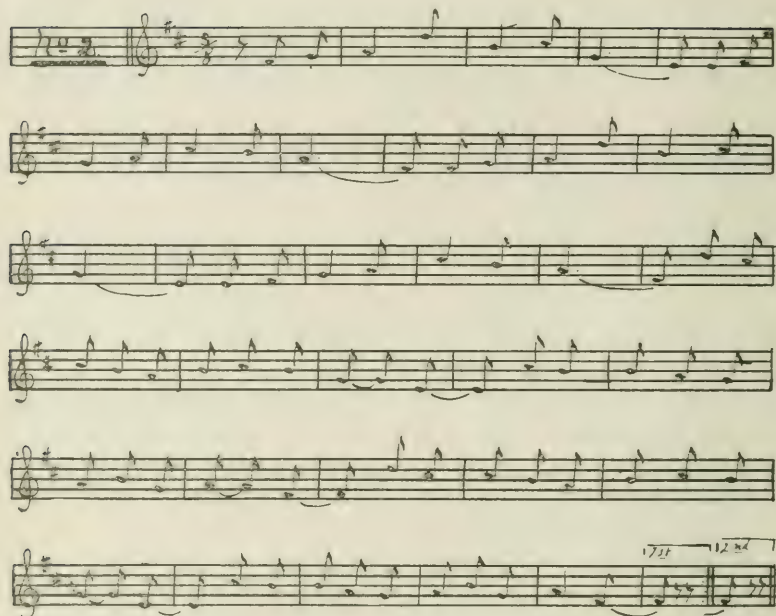
Hombre scá naha gurutí xuyu;
 Stubi gaxhé ngalá xandáguyu
 Tuhpeh naxhibé lihi ngá rulagu
 Ngangá ruxabinán dalu lah.

Another man, such as I, you'll not find
 Whatsoever other he be;
 In hating him who loves you,
 You despise your own love.

Que rixalahilicalu naha
 Yanaru biahaxhichení;
 Para naha racatih cuexalu;
 Más scarú né guenda stubi lucha.

I know that you do not love me,
 Now I know it right well,
 — — it is enough, enough,
 Leave me to dwell in peace.*

*; No sé que te pasa!	Por ti vivo suspirando,
Te vas sin decirme ¡Adiós!	Éso no esperaba de ti;
Yo aquí muriendo por tu amor;	Pero basta — basta — — vete — —
¡Adiós! ingrata, ya lo pagarás.	Ya lo pagaras.
Soy el sér más desgraciado;	Otro hombre como yo no hallaras,
Amo, y no estoy correspondid,	Otro cualquiera sí;
Amanezco divagado	Aborreces á quien te ama
Bién comprendo que así se ama.	Desprecias á tu mismo amor.
Ni á tu casa puedo visitar	Sé que no me amas
Tu familia me desprecia:	Ahora lo sé muy bien;
¿Puedo vivir así?	— Me basta, me basta — — —
¿Verdad, que no?	— — — Dejame vivir en paz.

*Laureana.*

Bipapa bidoh naxhiehé
 Bipapabé squihi stubi
 Xenebé guenda naxaca stine
 Guenda naxaca slaxhedoáh.

The angel, whom I adore, has flown,
 Flown to the unknown realm,
 Bearing with her the calm joy,
 Which illumined my faithful heart.

Jamás xaxelá guixhilayuh
 Sti bidóh gucuexá shiuhbá
 Cuehe dohorí yané
 Doho ni calluti naha.

Never again in life will I find
 Another angel to calm my woes,
 To remove from me the cruel chains,
 Chains which cause me to suffer.

Puro guenda rúna pobre spidá
 Saca cullubé alivio para naha
 ¿Shi modo guixhelá biní huarah?
 Alivio para lah que exiuhu.

To sing sadly and weep, now, is my life,
 Seeking balm for my sorrows:
 How can a wounded soul find relief.
 -- Relief can not come from her.

Xhíh né guéla callúná
 Guenda rúna stiné que cuexá
 Ngá guenda gutitih xucuxa
 Ngatih, ngatih, cabexá.

In weeping day and night,
 My tears have never ceased;
 They will cease only with death,
 And for death, death only, I sigh.

Birá bilushe esperanza napá
 Guixhilayu para naha ma bilushe
 ¿Shí fin gapá badohxhapa?
 Ni pah lado chahá, ni pah lado guenda.

Perish my fondest hopes,
 The world, for me, no longer exists;
 Who will be my angel? For me
 -- living alone, and ever alone.

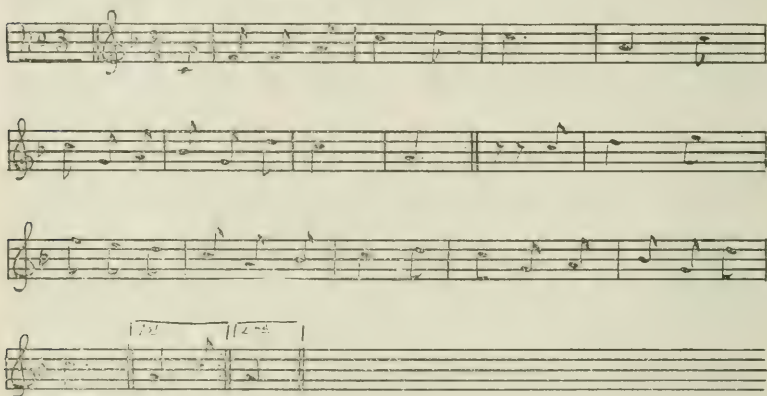
! Sin lihi que racalaxhe guibané
 Vida sin lihi, cadí vida;
 Ne lihitih racalaxhé guibané
 Guibané sólo para lihi.

Without thee, I care not for life,
 Life without thee is a desert.
 Only with thee do I care to live,
 And alone for thee to exist.*

*Voló el ángel á quién adoro,
 Y voló á regiones estrañas
 Llevándose consigo la calma,
 Que brindaba al fiel corazón.

Jamás en la vida hallaré
 Otro ángel que calme mis penas,
 Quitarme las crueles cadenas,
 Cadenas que me hacen sufrír.

Cantar y triste llorar es mi vida, Percieron mis esperanzas,
 Buscando alivio á mis pesares; El mundo para mí no existe;
 ¿Como hallar alivio un alma herida? Que será de mí, ángel mío? [do.
 Alivio para ella no habrá? Viviendo aislado, y siempre aisla-
 De día y noche llorando, Sin ti no quiero la vida
 No ha cesado mi llanto; La vida sin ti es un desierto;
 Y cesará solo con la muerte [pero. Sólo contigo quiero vivir,
 Y á la muerte, á la muerte, solo es- Y sólo para ti existir.



Eduarda.

Spidú né spídalú tubi
 Paráha chahá sin lihi
 Lihi squendú nabané,
 Ne lihi naha felíz.

My life and thine have united;
 Where shall I go without thee?
 If thou art my only good,
 In thee will my happiness consist.

Infelíz naha sin lihi
 ¿Pah lado chahá sin lihi?
 Guenda nabané stiné
 Rah mihulu xaxhelá.

Without thee I am an unfortunate,
 What motive have I, without thee?
 My life is with thee
 And only with thee will be.

Chih lihi gusianú naha

Xalushe guixhelayuh

Nanaxhiche sacáni:

Xhuncohuini, Xhuncohuini

Should you come to despise me,

I should die,

Indeed well, I know it:

My angel! my angel!

Sin lihi ¿shindi naha yia?

Nabaní por nabaní:

Runi, ni ganashi runi,

Raca ni guiní shi raca.

Without thee, who am I?

A lifeless body.

My soul raving

And ever raving.

¿Pah lado guyubé,

Pah lihi gulagu naha?

Que gapá lado chahá,

Mejor bindushecá naha.

What course should I take

If you should come to despise me?

I would have no course to follow:

Better you kill me.

Que xandá cuexa xhihcá:

Xhihcá unabes naroho;

Guidubi shiahná xené;

Guenda guli mejor.

I will not wait for that day,

For me so dreadful:

Which makes me tremble,

Death even is preferable.*

*Mi vida y tuya se han unido

¿Adonde ire sin tí?

Si tú eres mi único bien

En tí se cifra mi dicha.

Sin tí soy un desgraciado.

Que fin tendré sin tí?

Mi vida contigo esta,

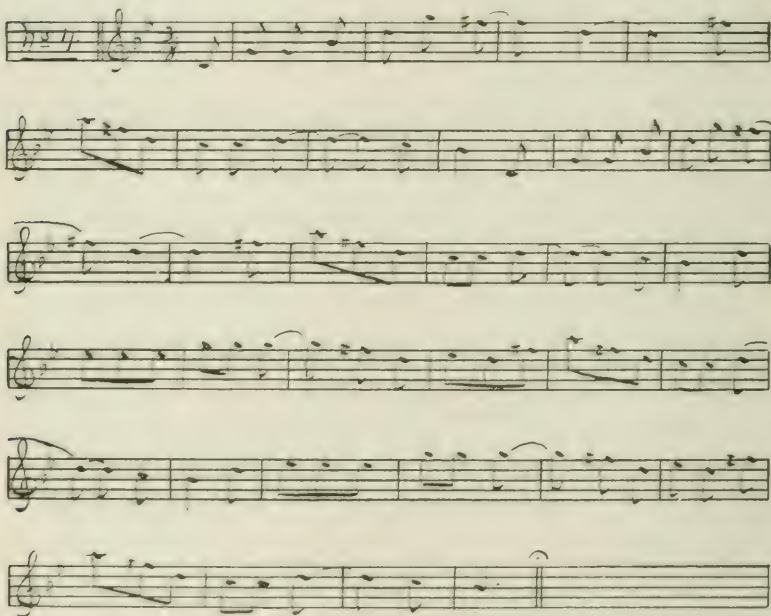
Y sólo contigo estará.

Si llegues á despreciarme,
 La vida perderé,
 Muy bien losé
 Angel mío, agel mío.

¡ Que rumbo tomaré,
 Si llegues á despreciarme?
 No tengo adonde ir,
 — mejor me mataras.

Sin tí ¿quién soy?
 Cuerpo inerte,
 Mi alma delirando
 Y siempre delirando.

No esperaré ese día;
 Que para mí es hórrido;
 Que me estremece,
 Es preferible la muerte.



Petrona.

Petronita, Petronita,
 ¿Shí bine culagu naha?
 Ngá que ribexa de lihi Petrona,
 ¿Shindi rácalu né naha?

Petronita, Petronita,
 What have I done that you drive me out?
 I did not expect this from you;
 What have you against me?

Petronita, Petronita,
 ¿Shí vida cutidé lihi?
 Ni quiñé, ni capá lihi, Petrona,
 Rah lixhu rulagu naha.

Petronita, Petronita,
 How have I harmed you?
 I have not struck you, nor pounded you,
 But you drive me from your house.

Petronita, Petronita,
 Rah lixhu runumandar,
 Tuh gacalaxhu xulagu, Petrona,
 Rah lixhu stúbilu dueña.

Petronita, Petronita,
 You command in your house;
 You drive out whom you please
 Queen, you are, of your house.

Petronita, Petronita,
 Xiahá sin gacalaxhé
 Guirá ni nahlu xune Petrona,
 Para cadi guixhichilu.

Petronita, Petronita,
 I leave without complaint,
 I will obey you in all things,
 So as not to trouble you.

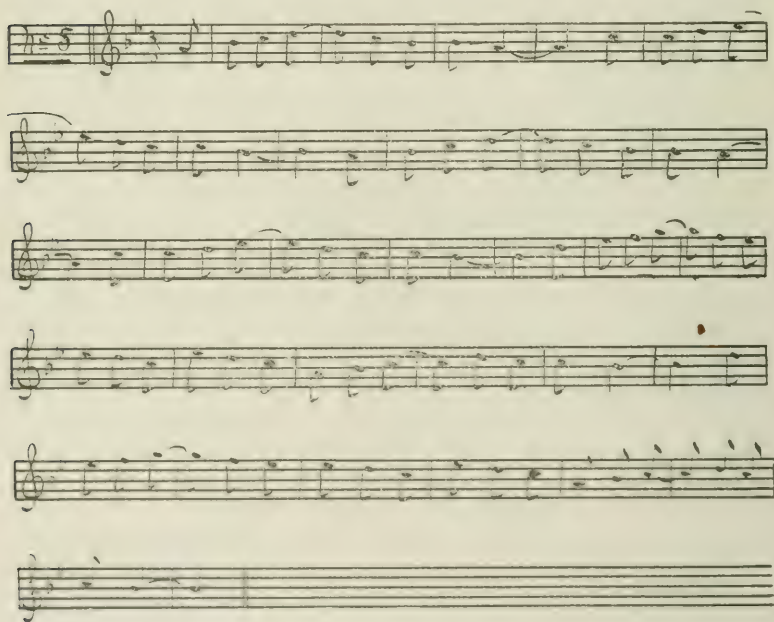
Petronita, Petronita,
 Jāmasrú xulayu naha
 Necá por lihi runa, Petrona
 Sacu lihisi risacu.

Petronita, Petronita,
 Nevermore shall you see me;
 Although I weep for you Petrona
 Think not that you only are of value.

Petronita, Petronita,
 Xaxhelá stubi scá lihí;
 Lihi nahlu que xanda, Petrona,
 Rahcá guidú yanú ni.

Petronita, Petronita,
 I'll find another as good:
 Think I can't, do you Petrona?
 Well, well, then—we'll see.*

*Petronita, Petronita, [chando? Petronita, Petronita,
 ¿Que he hecho que me estas es- Me retiraré sin querer,
 Eso no esperaba de ti, Petrona, Te obedeceré en todo,
 ¿Que es lo que tienes conmigo? Para no molestarte.
 Petronita, Petronita, Petronita, Petronita,
 ¿Qué mal le estoy haciendo? Jamás me volveras á ver;
 No te he pegado, ni puñeteado, Anuque por ti lloro, Petrona,
 Petrona, No creas que sólo tu vales.
 De tu casa me estás echando. Petronita, Petronita,
 Petronita, Petronita, Hallaré otra como tu,
 Tú en tu casa mandas, Creeras tu que no, Petrona,
 Echarás á quién gustas Para después lo veremos.
 Reina de tu casa eres.



Antonia.

Desprecio rúnilu naha,
 Para guíánu stubú,
 Que gandá guicahani,
 Necá naba nacàlaxhe.

Your disdain toward me
 For deserting you:
 I do not feel it,
 Although I ought.

Guibah né guixhilayuh
 Bisenda guiropamí
 Para ganashiehé lihi:
 No tubiluchatih lihi.

Heaven and earth
 Have sent us here,
 That I may love you,
 And only that I may love you.

¿Shi modo rulagu naha?
 ¿Naha gulagu la?
 ¡Mejor nuticalu naha!
 Auta mulagalu naha.

Why do you disdain me?
 Do you disdain me?
 Better destroy me!
 But do not disdain me.

¿Shindí ribexa sin lihi?
 Lihi guié guixhilayuh;
 Lihi llave stid shialma
 Lihipeh misma spidá.

What hope without you?
 Rose of the world,
 You are the key of my soul,
 And my very life.

Hora lihi que guinú
 Ni guixhelá shí guné;
 Ni ganá shingá racá;
 Laxha lu bih ribexá.

In your absence,
 I find naught to employ me.
 I know not what transpires:
 I seem to live vacantly.

Mas stúdolu nuaha gloria
 ¿Tungá más feliz que naha?
 Que xandá guixhelu stubi;
 Feliz tubilucha naha.

But at your side is my glory,
 Can one be more happy than I?
 It is impossible;
 I, only, am happy.*

*Tu desden para conmigo
 Por dejarte,
 No lo siento,
 Aunque lo deseara yo.

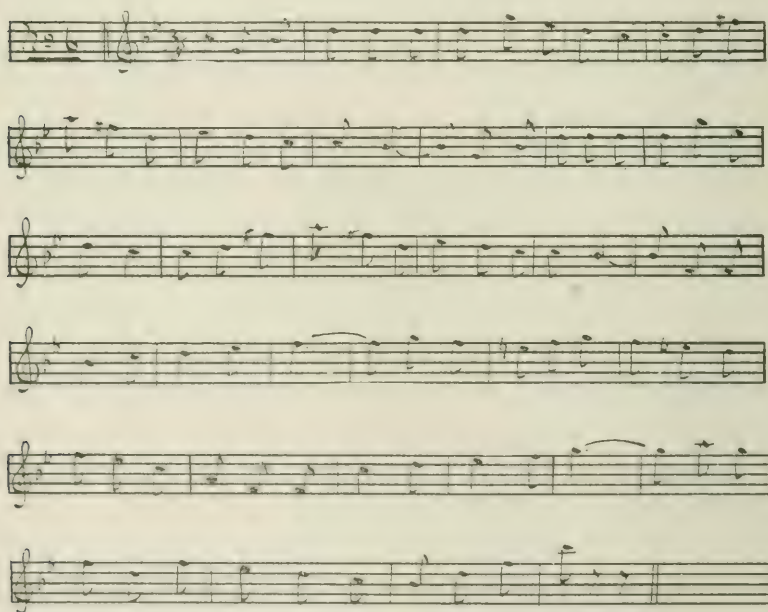
El cielo y la tierra
 Nos han enviado acá
 Para amarte yo
 Y sólo para amarte.

¿Por qué me desdeñas?
 ¿Desdeñarme tú!
 ¡Mejor acaba conmigo!
 Y no desdeñarme tú.

¿Qué espero sin ti?
 Rosa del mundo;
 Tu eres llave de mi alma
 Y mi vida misma.

En tu ausencia
 No hallo en qué ocuparme;
 No sé que me pasa;
 Se me figura que en el aire vivo.

Mas á tu lado, es mi gloria
 ¿Habra otro mas feliz que yo?
 Imposible es que haya;
 Feliz único yo.



Mi Angel.

Badohuini ni naxhiehé
 Sladolu racalaxhe cuexá
 Né para lihutih guibané
 Ne para lihutih guibané.

Beautiful angel, whom my soul adores,
 'I desire to live at thy side,
 And only to exist for thee,
 And only to exist for thee.

Lihi runichahuilu shialnia
 Ruchechuí shiubá
 Ruchalu guié tuexá
 Rusabinándalu guira yuhba.

Thou adornest my grieved soul,
 Dissipatest my cruel torments;
 Strewing my path with flowers,
 Calming my suffering.

Biniseguir suexu, ángel stiné:
 Bini feliz' tuh naxhihi lihi:
 Triste hombre ni cacahalaxhi por lihi:
 Triste hombre ni callúna por lihi.

Follow, my angel, thy happy path,
 Causing joy to him that loves thee well,
 To the wretch who sighs for thee,
 To the wretch who weeps for thee.

De alegría callúna por lihi,
 Dueño stid scorazonlu
 Ne alegría siempre xanoshih
 Corazonhuini stid.

With joy, weeping for thee, lives
 The owner of thy faithful heart;
 With joy, loving, will follow thee
 Thy loving, tender and faithful heart.

¡Ojala! ñandá ñandá ñunadiágalu
 Gloria ni runèsentir:
 Ñabé lihi né dixha scarú
 Guenda naxacá slaxhedooh.

Ah could I but sing to thee
 The pleasant emotions I feel!
 Could I but tell thee, in sonorous lines,
 The great joy my bosom holds!

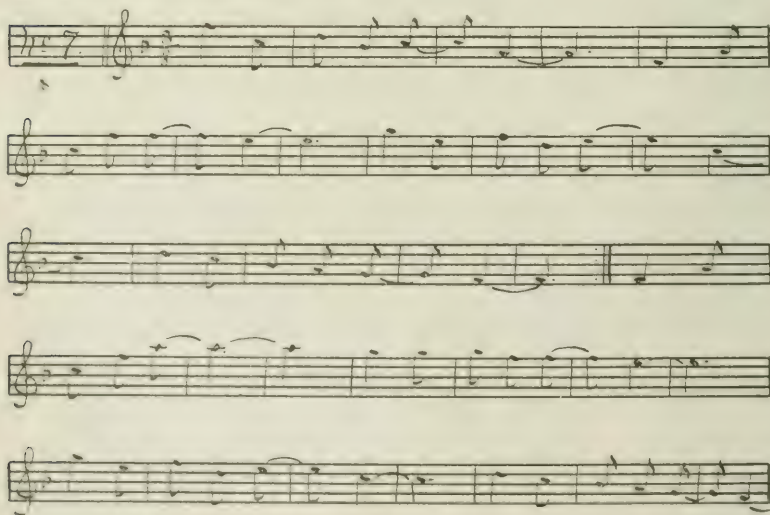
Xhunco, má xiahá ndi
 Bidóh gulé para naha
 Biani de ahua stiné
 Gloria stiné.

Withdraw from me thy sweet charms,
 Oh nymph, indeed, born for me,
 Cloud of light, whom my soul adores,
 Eternal mansion of my hope.*

*Angel bello, que mi alma adora, De alegrías te vive llorando
 A tu lado quiero vivir, El dueño de tu fièl corazon,
 Y sólo para tí existir, Con alegrías te seguirá amando.
 Y sólo para tí existir. • Su fièl, tierno y dulce corazon.

Tu adornas mi alma adolorida; ¡Ojala! pudièse yo cantarte
 Disipas mis crueles tormentos: Las gratas emociones que siento;
 Regando de flores mi senda; Repetirte en versos sonoros
 Anyentando el duro sufrir. La gran dicha que encierra me
 Sigue, ángel mio, tu senda de dicha pecho.

Haciendo feliz á quien bien te Me retiro mis dulces encantos,
 ama; Nínfa que, para mi bien nacida,
 Al triste ser que por tí suspira Ráfaga de luz que mi alma adora,
 Al triste ser que por tí llorando. Eterna mansión de mi esperanza.





Antonia.

¡ Antonio ingrato !

¿ Shí biní lihi

Bisanú naha

Sin ti motivo?

Ingrate! Antonio!

What have I done to you,

That you should leave me

Without reason?

Xehlu sin gastí

¿ Shingá callácahi?

Nuahá por lihi

Gastí callaca.

You avoid me without cause,

What ails you?

On my part

Nothing.

Shamoar napú

Stidlu napá

Felíz guirópanú

Bigueta xhona.

When you have my love,

And I have thine,

Happy are we;

Return, then.

Cadi guindahu

Rúná por lihi

Pah que guedú

Xate sin lihi.

Delay not!
 For you I sigh;
 And if you come not,
 For you I'll die.

Shiahuá callagui
 Por amor stidlu
 Lihi spidoáh
 Lihi spidá.

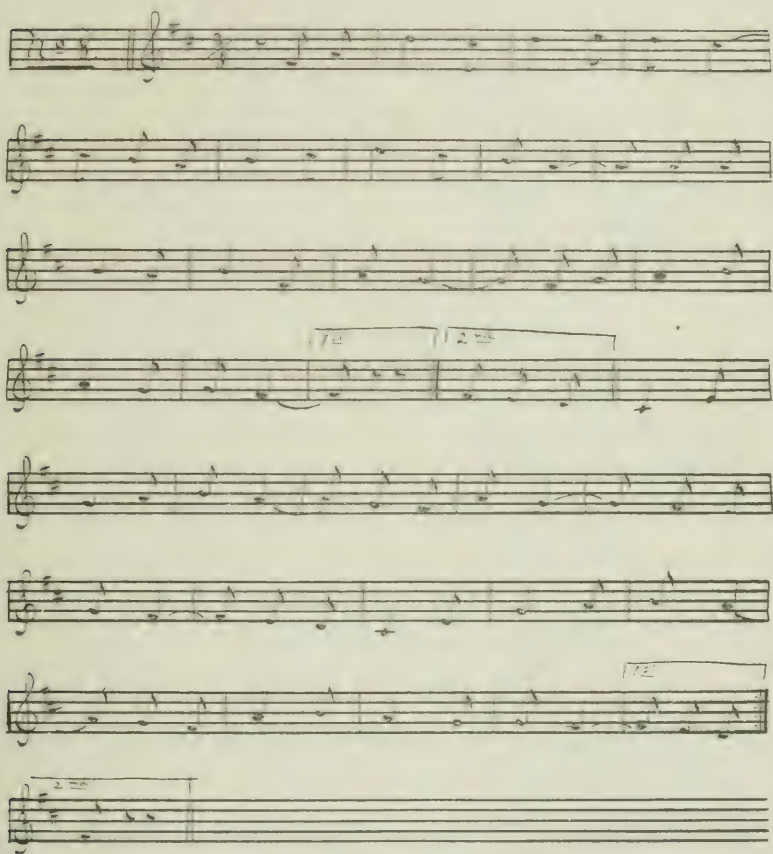
My soul burns
 For thy sweet love;
 Yes—angel mine;
 Yes—my life.

Xhona gudáh,
 Cabexá lihi,
 Lihitih ruchan,
 Laxhèdoáhrí.

Come, angel mine,
 For you I am waiting.
 Only you are fitted
 To my faithful heart.

*Ingrato Antonio
 ¿Que te he hecho?
 Que me dejas
 Sin motivo alguno.
 Te fuiste sin motivo
 ¿Que te esta pasando?
 Por mi parte
 Nada nos pasa.
 Mi amor tu tienes,
 Y el tuyo lo tengo;
 Felices somos,
 Regrésate, luego.

No te tardes
 Por tí suspiro;
 Y si no vienes,
 Morire por tí.
 Mi alma ardiendo
 Por tu dulce amor
 Sí, angel mío,
 Si, vida mia.
 Ven, ángel mío,
 Te estoy esperando,
 Sólo tú llenas
 Mi fiel corazón.



Morena.

Badohxhapa shunashi gué,
 Stádolu naha felíz;
 Necá que ganá gondá;
 Pero por lihi callondá.

Most beautiful maiden,
 At thy side I am happy;
 It is not my forte to sing,
 But, for thee, I will sing.

Sládotilu xabané
 Lihitih vida stiné
 Sin lihi xanitèluáh
 Vidarí stidlu quidubi.

Only at thy side will I live,
 Angel of my affections;
 Without thee I will perish,
 Beautiful mistress of my life.

Desde chihgucabíah lihi,
 Amor stíu cuxaqui naha,
 Ni ti momento de gusto;
 Ahuari siempre caguíh,

From the day that I knew thee,
 I burned with sublime love for thee;
 Not a moment calmed,
 My soul always burning.

Dixha scarú que gapá:
 Para nandá nabé lihi,
 Pah amor napá lihi,
 Badohxhapa spidáhuine.

I possess no adequate phrases,
 For expressing to thee,
 The eloquent love which I feel,
 Beautiful angel.

Ni ti rato ñacàlaxhe
 Naxha rah nuhulu xhinico,
 Porque lihi guié stiné
 Guié gundaní lachèdoáh.

Not a moment do I desire
 To depart from thy side;
 Because thou art the hope
 Of my life, darling.

Lihí rudíu vida naha;
 Sin lihi que xabané;
 Squendá nabané nga lihi;
 Dudará que xandá gápalu.

From thee I receive life;
 Without thee I cannot live;
 Thou art the life of life to me;
 Do not doubt it.*

*Hermosisima joven,
A tu lado soy feliz;
No es mi destino cantar;
Pero por tí cantaré.

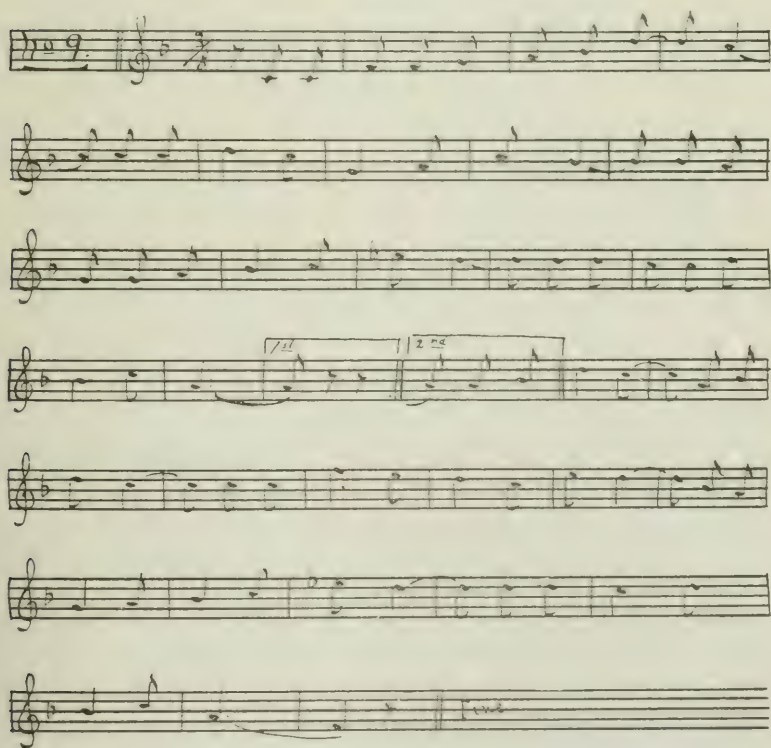
Sólo á tu lado viveré,
Angel de mis amores;
Sin tí pereceré,
Hermosa dueña de mi vida.

Desde el día que te conocí,
Yo abrasado de tu sublime amor;
Ni un momento sosegado;
Mi alma siempre ardiendo.

Melodiosas frases no poseo,
Para expresarte
El elocuente amor que te profeso,
Angel bello.

Ni un momento quisiera
Separarme de tu lado,
Porque eres la esperanza,
De mi corazon, nacida.

De tí recibo la vida;
Sin tí no viviria:
Tu eres mi mismísima vida,
No has de dudarlo tú.



Julianita.

Bieté guixhilayuh sin dicha
 Gastí alivio para naha;
 Rondá para chuahá alegre,
 Lagalá rínaha mas triste.

Unhappy came I into the world,
 There is no happiness for me;
 I sing to rejoice myself,
 But it saddens me more.

Tipah laxhedoáh de yúhba,
 Gulé para sufrimiento
 Gabaté guicahá bih
 Guirá lado lacá yúhba.

Lacerate my heart,
 Born to suffer;
 For me there is no alleviation,
 Sorrows, and more sorrows.

Rah núhutilu, badohx hapa,
 Guidubi amor stiné nuhu
 Gabatirú gandá chuhu;
 Porque tubisi amor nuhu.

Only at thy side, my angel,
 I pour forth my sweet love,
 And only at thy side,
 Elsewhere I cannot.

¡ Ojala! ñacu scá naha,
 Tubisi laxhídóh ñápamí,
 Nixami tubisi nexa:
 Nechenú tubisi yoho.

Ah! wert thou as I am,
 Our hearts united,
 We would journey together,
 And together delight ourselves.

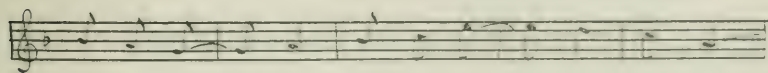
Lihí gultí para naha
 ¿Shi modo gusianá lihi yíá?
 Ndani shialmacá ribáxalu
 Rixhí, huashini nuhulu.

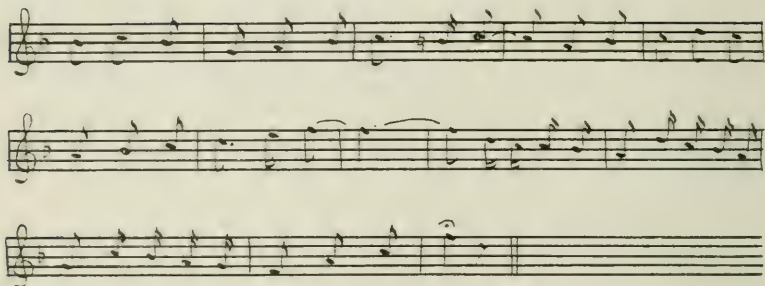
Thou wast born for me;
 How can I leave thee?
 By day and by night thou dwellest
 In my sad soul.

Pah lihi rulagu naha,
 Xami triste fin stiné:
 Rah bah stiné cheh gunú;
 Porque sin lihi xaté.

If thou shouldst abandon me,
 Thou wouldst learn my tragic end,
 Thou wouldst weep o'er my tomb,
 Because without thee, I'd die.*

*Desgraciado vine al mundo,	¡Ojalá! fueses como yo,
Para mi no hay dicha;	Nuestras corazones unidos,
Canto para alegrarme;	Caminaríamos juntos los dos,
Y me entristezco más.	Y nos divertíamos los dos.
Despedazad mi corazón,	Tu naciste para mí,
Nací para sufrir,	¿Como había de dejarte?
No hay para mi un alivio	De dia y noche vives
Pesares, y mas pesares.	En mi alma adolorida.
Sólo á tu lado, ángel mío,	Si tú me abandones,
Derramo mi dulce amor,	Ya sabrás mi tragico fin,
Y sólo á tu lado hago,	Llorarás sobre mi tumba,
En otra parte no puedo.	Porque sin ti moriré.





«Luisa.

Niné rondá gastí cahua
 Chuhu ndani laxhedoah
 ¿Shí modo ndi gapá calma,
 Tuh naxhihí naha guti?

Notwithstanding my songs,
 My griefs are not mitigated;
 How could they be mitigated,
 If my most beautiful angel die?

Napá razón gunàshata
 Que xandá gapa stí amor;
 Tan naroho, tan nanashi:
 Casi ni gupá primero.

Greatest reason have I for weeping,
 For other love I will never have,
 So sweet, so sublime,
 As my first love.

Nagaci que guixhelá
 Shí tindí xandá guné
 Rixilúa galahá guté,
 Por gutí tuh naxhiehé.

In these moments I cannot decide
 What to do;
 Half-dead am I,
 Think of it, my faithful love lies dead.

Napá ti yuhba naroho
 Que xandá gacaexplicar
 Pah ñacaexplicarnilá,
 Queto rusábani naha.

I feel acutest grief,
 Inexplicable,
 Could you explain it,
 I should die.

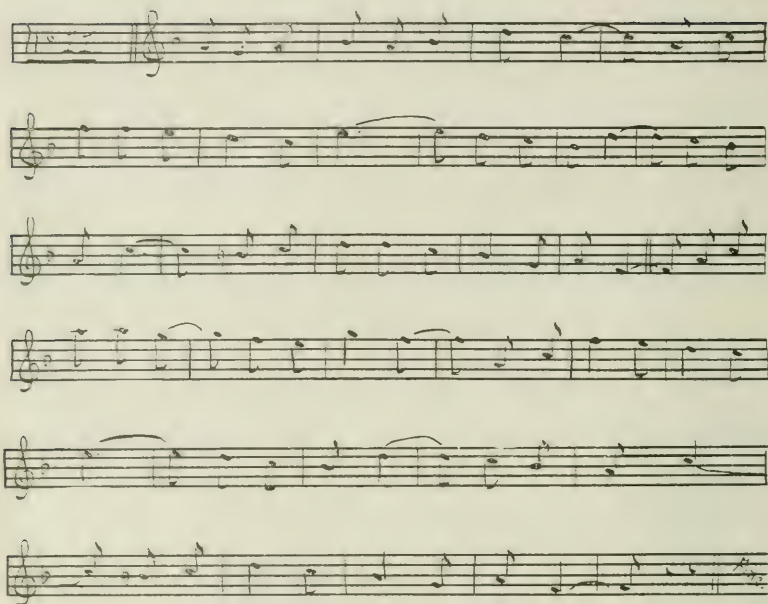
Gastí alivio cuexa naha,
 Alivio stiné guyaqui;
 Ngá que xandá guedá nunca
 En vano gabé; cuexa.

There is no consolation for me,
 My consolation has perished;
 I will not expect it,
 'Tis vain to expect it.

Mejor guyubé stí nexa;
 Porque nexacá má xéh;
 Que xandá chuhu stubi;
 Necá ñacalaxhe ñuhu.

'Tis better to seek another angel,
 Since this one has flown,
 And ne'er will return,
 Though I wish that she might.*

*No obstante mis cantores,	Siento un agudísimo dolor,
Ni se mitigan mis dolores;	Inexplicable,
¿Cómo se me habían de mitigar,	Si lo llegase a explicar,
Si mi ángel bello se me murio?	Muerto me tendrías.
Muchísima razón tengo en llorar	Lenitivo para mí no existe,
Otro amor jamás tendré:	Mi lenitivo ha perecido;
Tan dulce, tan sublime	No lo esperaré;
Como mi amor primero.	Eu vano esperararlo.
En estos momentos no hallo	Preferible es buscar otro ángel,
----- Que hacer	Que ese ángel ya voló;
Medio muerto estoy,	Y ya no volverá;
Figurate, cadáver mi fiel amado.	Aunque lo quisiese yo.

*Marina.*

Niña, nanú de que naha
 Rate rilushé por lihi:
 Lihipeh ruyubé yanna
 Buena ocasion ridi bixhina.

Dear girl, thou knowest,
 That for thee I drink the air,
 In search of thee, I wander,
 'Tis a delight to have found thee.

Xandá gunadiágulu naha,
 Rinabá lihi por Dios:
 Callaté por amor stidlu
 Ni descanso ti momento.

Listen to me,
 For God's sake! I beg;
 I am dying for thy love,
 And ceaselessly suffer.

Bíaha tuh nanhixhí lihi
 Lu shiúhba gundisá lah;
 Nunca gunidespreciarlu
 Tuh xhandi ruyubí lihi.

Pity him who loves thee,
 Console him in his grief,
 Ne'er show disdain
 For him who loves thee truly.

Guixhilayuh gastí dīxha
 Nūnēpintar amor stīdlu;
 Nī cuexaquī scorazoán:
 Nī que gusana silaxhe.

There are not, in the world, words adequate
 To paint the love for thee
 Which inflames my heart,
 Which permits me no rest.

Naxhiehe lihi sin fin:
 Guiechachí para spidá,
 • Unico amor shiahuá
 Amor de guirá amor.

Great is my love for you,
 Refulgent star!
 Balm of my soul!
 Love of my loves!

Alegría né lihi nuhu;
 Tristeza nuhu né naha;
 Vida né lihi nuhu:
 La muerte nuhu né naha.

Joy lives with thee,
 Sadness with me;
 With thee, life,
 With me, death.*

*Niña sabes
 Que por ti los aires bebo,
 En busca tuya ando
 Es una gloria el haberle hallado.

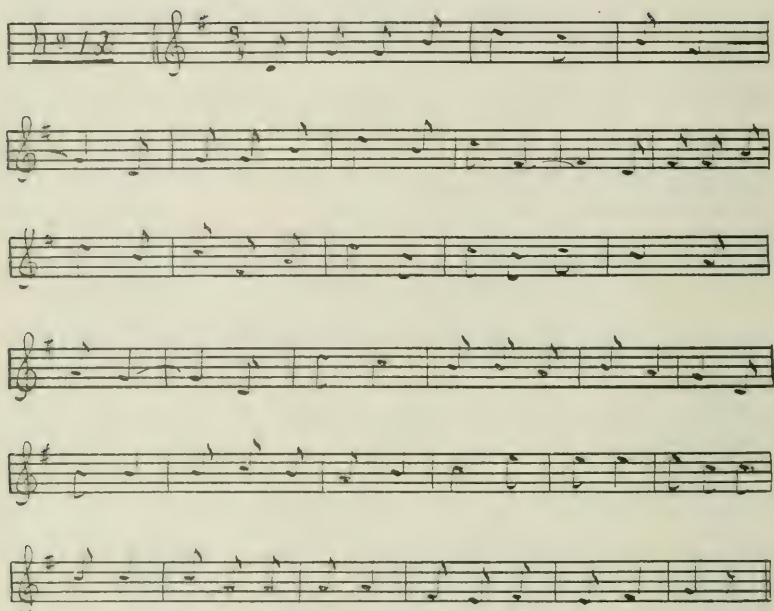
No hayen el mundo expresivas frases
 Para pintarte tu amor,
 Que abrasa mi corazón;
 Que ni descansar me deja.

Escúchame
 Te lo suplico por Dios,
 Muriendo yo por tu amor,
 Sufriendo sin cesar.

Es mucho lo que te amo;
 Estrella refulgente,
 Alivio de mi alma,
 Amor de mis amores.

Compadécete de quién te ama,
 Consuélale en sus pesares;
 No desdeñarlo jamás,
 Á quién deveras te ama.

La alegría contigo vive;
 Y conmigo la tristeza;
 Contiga la vida;
 Y conmigo la muerte.

*Aurelia.*

Mejor que ñacabiáh lihi
 Que huallandá silaxhe
 Lixhiguibah hualluahá
 Por amor ni napá llihi.

'Twere better not to know thee!
 I have not rested a moment,
 I have lived in a prison,
 For the love which I have for thee.

Gurutí hualluni naha
 Quirá ni yanna calluni
 Amor stidlu, amor stidlu;
 Bidubi spiané xené.

No one has e'er done to me
 What now is being done:
 Thy love! thy love!
 I am deprived of judgment.

Nabané de puro yúhba
 Por lihi siempre por lihi;
 ¿Shindirú xandá guné,
 Pah cadi guné por lihi?

I tread a rough path,
 For thee—ever for thee:
 What can be done,
 That I would not do for thee?

Pah guenda ronda que ñuhu,
 Nirá enamorado ñate;
 Guenda ronda rucuxá
 Algo shiuhba tuh callati.

If song did not exist
 All lovers would perish;
 Singing softens
 The grief of the sufferers.

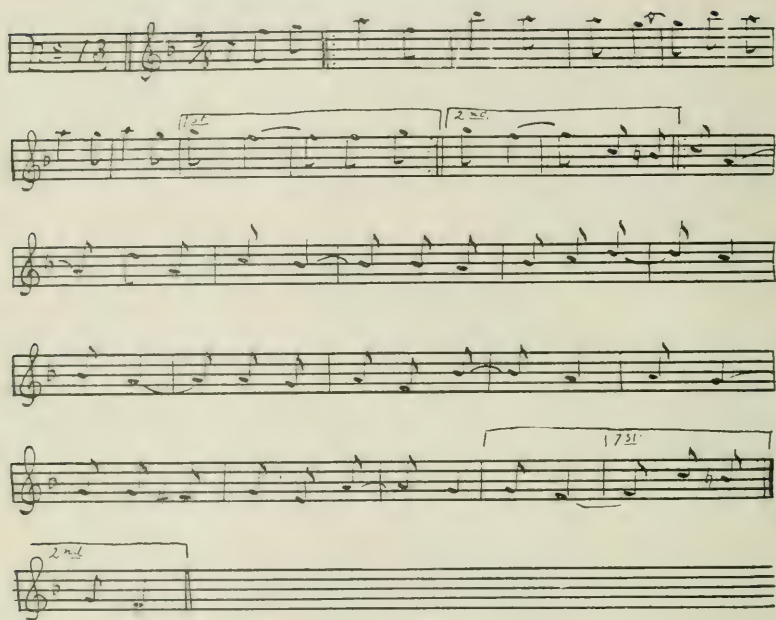
Esperanza stiné lihi
 ¿Tungú guninegarui?
 ¿Naha lá? que xandá;
 Halasha lihi gandá.

Thou art my hope!
 Who can deny it?
 Do I deny it? I could not—
 Much less canst thou.

Gurutirú xandá
 Gunicamar chashiúhba
 Lihi tubilucha lihi
 Sin lihi né guenda guti.

No one could calm
 My cruel sufferings;
 Only thou, and thou — — —
 Without thee, I prefer to die.*

*Valdría mas no conocerte,	Si el cantar no existiese,
No he descansado un momento,	Todos los enamorados perecieran.
En una prisión he vivido,	El cantar suaviza
Por el amor que yo tengo.	Los dolores de los que sufren.
Nadie me ha hecho	Tú eres esperanza mía
Lo que ahora me esta haciendo	¿Quien lo puede negar?
Tu amor, tu amor;	¿Negarlo yo? no podré;
Se llevo mi juicio entero.	Y mucho menos negarlo tu.
Cruzo una senda escabrosa	Nadie podrá calmar
Por tí y siempre por tí;	Mis crueles sufrimientos;
¿Que podría hacer,	Sólo tú y tú
Que por tí no lo haría;	Sin tí prefiero morir.



Paco.

Cadi~gacu~naguih
 Casi naha~né lihi;
 Triste guenda naguih;
 Lacá lah rutí amor.

You are not jealous,
 As I am of you:
 Sad 'tis to be jealous:
 Jealousies quench love.

Né laní gastí gusto
 Guidubi vida yúhba
 Ni ti momento alivio;
 Guenda naguih ti lado.

With jealousies there is no pleasure;
 Life is a martyrdom,
 With not an instant of joy;
 'Tis well to discard suspicions.

Guruti rihu bién.
 Pah gaca naguih;
 Guenda naguih veneno
 Stid guirá corazón.

No one takes pleasure
If he is jealous;
Jealousies are a poison
Of all hearts.

Tu racalaxhi chuhu
Né ti vida felíz;
Gapá guenda naguñh
Casí de ti serpiente.

Who desires to live
A happy life,
Avoids jealousies
As he would a serpent.

Gastí felicidad
Ne biní naguñshata;
Porque guenda naguñh
Biní mejor rundushe.

There is no joy
With the jealous;
Because jealousies
Disconcert all.

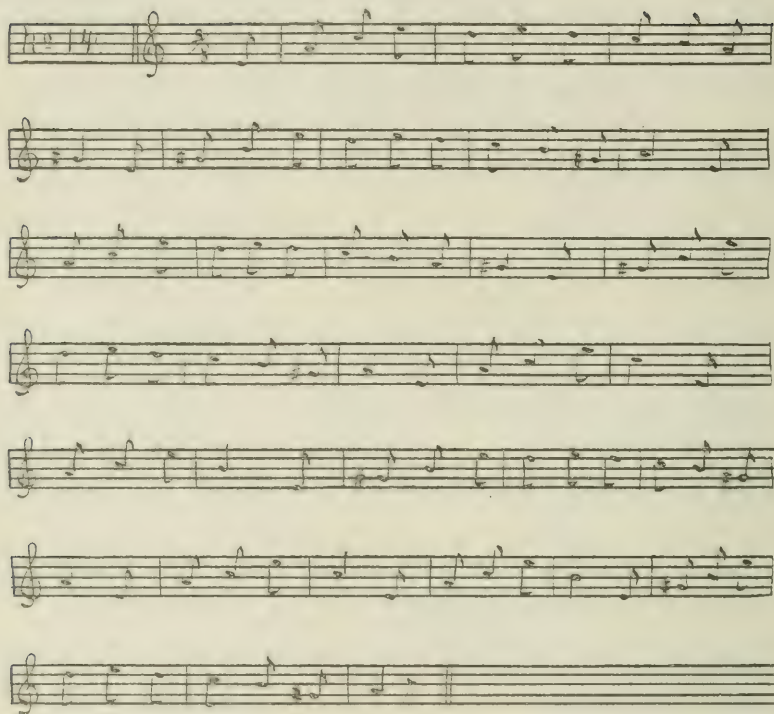
Bién racalaxhé chuhucanú
Necá vida nachucu
Sacá xaca naxiula
Né xácanú felíz.

I wish we may live happy
Though life is short;
Thus 'twill be prolonged
And will give satisfaction.*

*No seas celoso	Quien desea vivir
Como yo contigo;	Con una vida felíz;
Triste es ser celoso	Huya de los celos
Los celos apagan los amores.	Como de una serpiente.

Con los celos no se goza;	No hay felicidad,
La vida es un martirio,	Con los celos;
Ni un momento se goza;	Porque los celos
Conviene despreciar los celos.	A todos descomponen.

Nadie goza	Felices deseo que vivamos;
Si es celoso;	Aunque la vida es corta;
Los celos son veneno	Así se prolongará
De todos los corazones.	Y felices nos hará.



Pablo.

¿Shí biné lihi xehlu?

Bixabé naha yanna,

Naná que guxabé

Lihi gastilicá.

What have I done to you that you avoid me?

Orphan am I, today,

I know that I have done nothing,

Absolutely nothing.

Rúna de sentimiento

Ruyá desgraciari

Chuhu tuh guni mal

De ti biní nayla nuhu.

I weep from emotion

In contemplating this misfortune;

Some one must be working ill

To a virtuous person.

Que ganá shingá raca
 'Quixhilayuh cashiñe:
 Gudfh stid tubi stubi,
 Sin ganá shí calluni.

Sadly I look on the world,
 Going to ruin;
 It gives not to each one its due,
 Nor knows what it does.

Pah yaná shingá runi
 Cada tubi nudfh;
 Ni runitocar lah:
 Ti gloria ó sufrimiento.

If but it recognized its evil work!
 If 'twould give to each
 His due,
 To one reward, to another punishment.

Naha nicahá gloria
 Naha ti recompensa
 Naha ti guiebichita
 Nahatih, nahatih.

To me it would give reward,
 A recompense,
 A wreath,
 To me and to me alone.

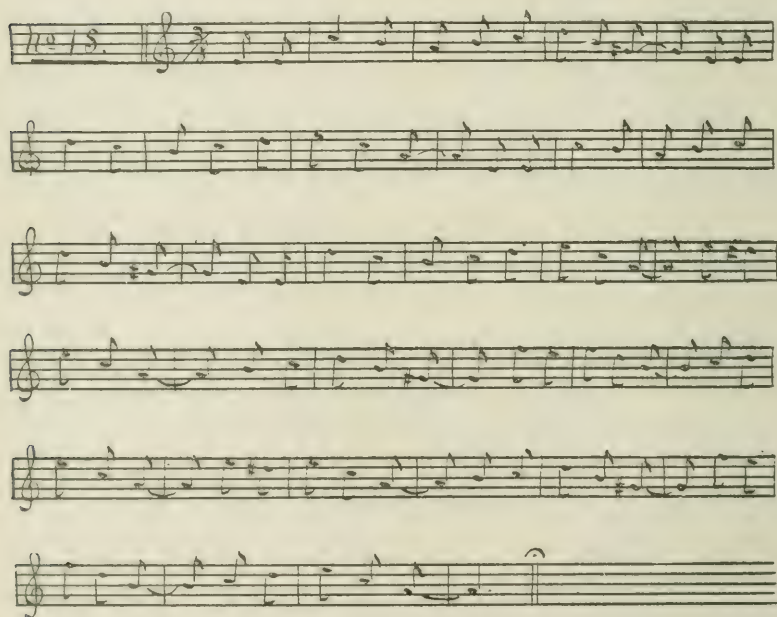
Tuh ñuninegaruí
 ¿Ti gunaha naxaca,
 Ti gunaha risaca,
 Ti gunaha stiduí?

Who can refuse,
 To a good woman,
 To a virtuous woman,
 What she deserves?*

*¿Que te hice que te fuiste?
 Huerfana soy ahora,
 Sé que nada he hecho
 Absolutamente nada.

Lloro de sentimiento
 Contemplando esta desgracia,
 Háya quien perjudique
 Á una persona honrada.

Asombrada veo al mundo	Á mí me tocaba un premio,
Que se ve á pique;	Una recompensa,
No dar á cada uno lo que es tuyo,	Una guirlanda,
Ni sabe lo que hace.	Á mí y sólo á mí.
Si conociese su mala obra,	Quién pudiese negar
Diese á cada uno	Á una mujer buena,
Lo suyo	Á una mujer honrada,
Á quien premio, a quien castigo.	Lo que bien merece?



Placido.

Novio stiné guti
 Túh ñábiní naha:
 ¿Shí fin gapá yanna?
 Lahpehbé ngá guti.

My lover is dead!
 Who would have told me!
 What end have I left in life?
 My angel has flown.

¡Jah suerte chaparra!

¿Shingá bini naha?

¿Shí nuxabé lihi,

Gacadesquitarlu?

Oh wretched fate!

What have you done to me?

What have I done

To deserve such punishment?

Gastí huallumé

Para gaca tanto;

Que xandá quishé

Ni que guxabé.

I have done nothing

To deserve so great punishment;

I ought not to suffer

For what I've not done.

Quishe cada tubi

Ni bini rarí;

Tubisí que quishe

Obra stid guira.

Each one in the world

Pays for what he has done;

'Tis not just that one pay

For what others have done.

Pah tubisí ñaca

Ni naha gucá

Cada tubi ñati

Ni tuh nibaní.

If to one alone should happen

What now happens to me,

He would die under it;

No one would remain in the world.

Mas quira vididi

Guixhilayuh;

Gastí sin que tidi

Casi ni xéhpapa.

But everything passes

In the world;

Nothing endures,

All passes, flying.*

*Murió mi novio

Quién me lo hubiera dicho:

¿Qué fin tendré en el mundo?

Mi ángel ya voló.

¡Oh, suerte chaparra!

¡Qué me has hecho?

¿Que te he hecho,

Para castigarme así?

Nada he hecho

Para merecer tantos castigos;

No he de pagar

Lo que no he hecho.

Cada uno en el mundo

Pague lo que haya hecho;

No es justo que uno pague

Lo que otros hayan hecho.

Si á uno solo le pasase

Lo que ahora á mí me pasa

Muérese en al acto,

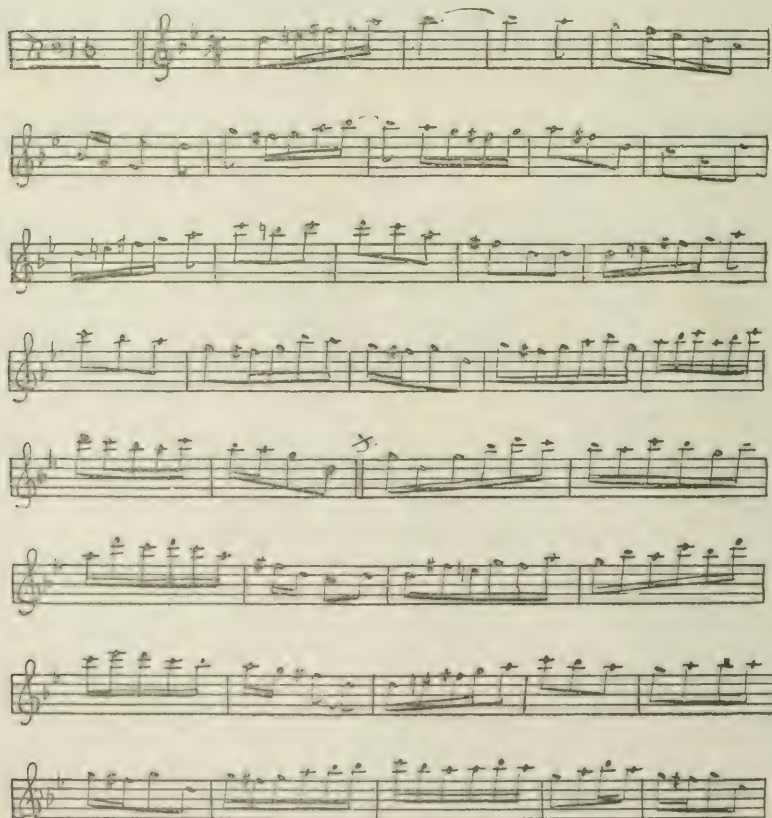
Nadie en el mundo existiría.

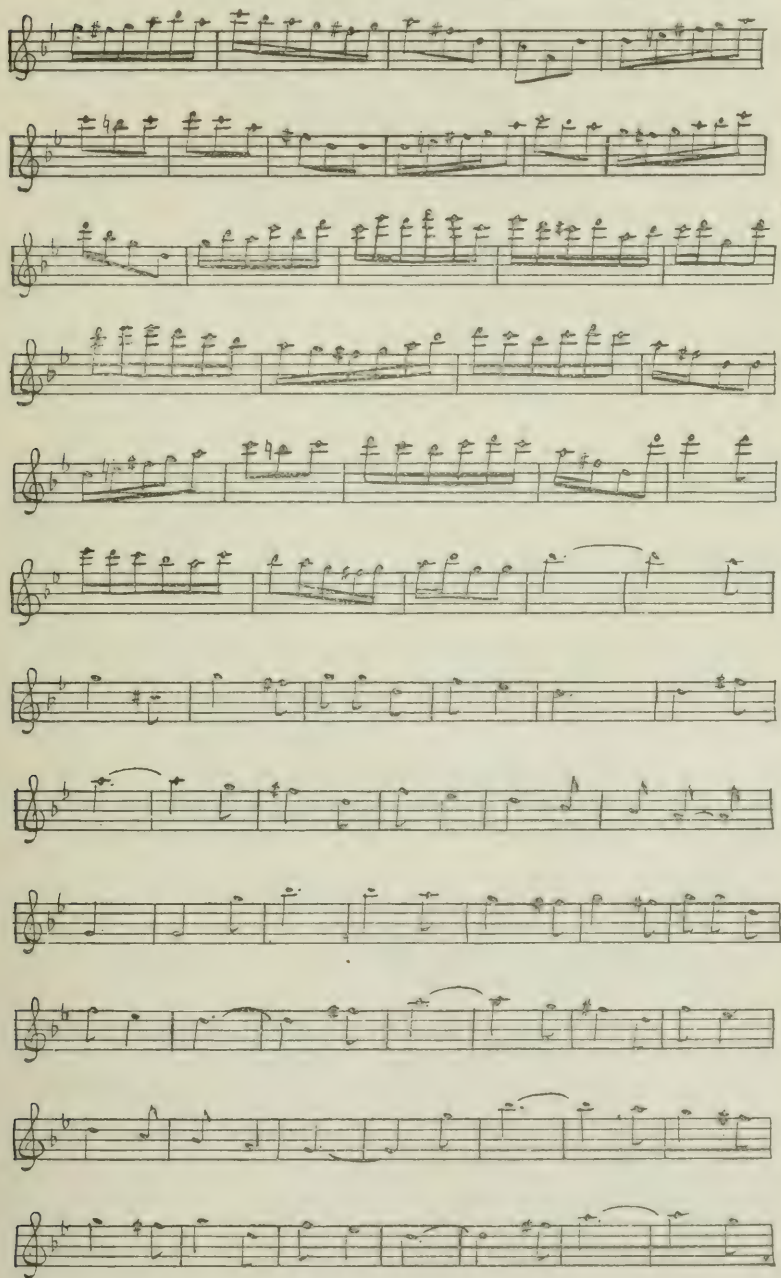
Mas todo pasa

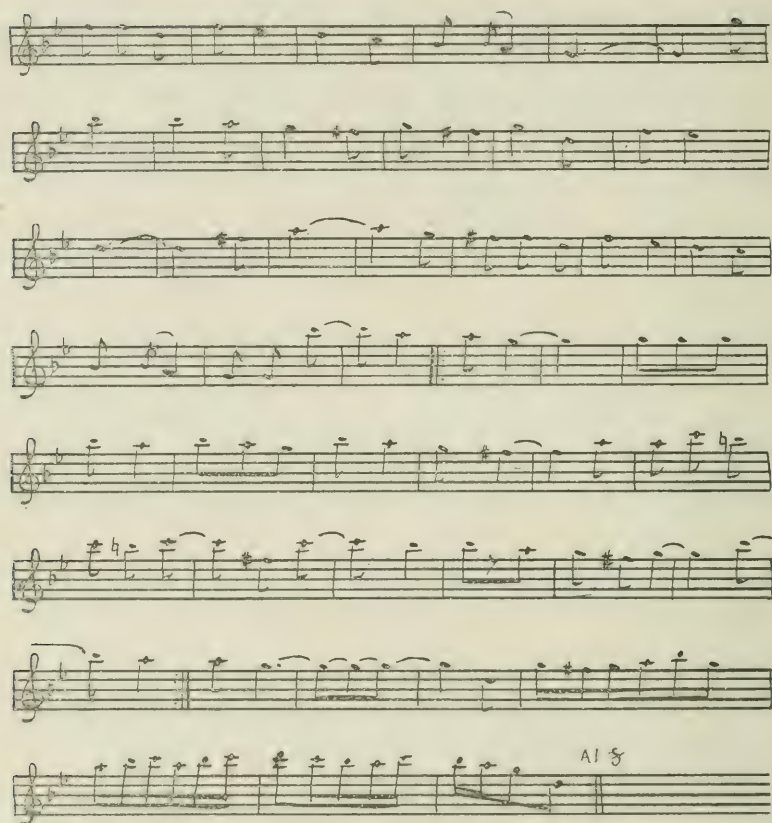
En el mundo;

Ninguna cosa dura,

Y todo pasa volando.







Zandunga.

Zandunga, por lihi calluna, mama por Dios:

¿Paráha nabéxalu, cielos de amor?

Lihipeh quendayubé, mama por Dios;

Amor stibu calluti naha, cielos de amor.

Zandunga, weeping for thee, mama por Dios:

Where dost thou live, heavens of love?

In seeking thee, I wander, *mama por Dios,*

Thy love is killing me, heavens of love.

¡Ay, Zandunga!

¡Que Zandunga rutí, mama por Dios!

Zandunga que gutú naha,

Prenda de mi corazón.

Aye! Zandunga!
 Zandunga who kills, *mama por Dios*,
 Zandunga do not kill me,
 Joy of my heart.

Zandunga pah lado chaha, *mama por Dios*;
 Pah que nan chuaha rah niehulu, *cielos de amor*
 Gulé para lihi, *mama por Dios*:
 Laxhèdoáh rabini naha, *cielos de amor*.

Zandunga, what end shall I pursue, *mama por Dios*,
 If you despise me, heavens of love?
 I was born for thee, *mama por Dios*,
 My heart tells me so, heavens of love.

¡ Ay Zandunga!
 Que Zandunga rucibaní, *mama por Dios*:
 Zandunga naha bicibani,
 Ángel de mi corazón.

Aye, Zandunga!
 Zandunga, who gives life, *mama por Dios*,
 Zandunga give me life,
 Angel of my heart.

Zandunga mientras nabané, *mama por Dios*:
 Rah lixhu gondá siempre, *cielos de amor*:
 Lixhu ngá gacá lixhé, *mama por Dios*:
 Spidá gaca spidalu, *cielos de amor*.

Zandunga, while I live, *mama por Dios*,
 I will sing in thy house, heavens of love;
 Thy home will be mine, *mama por Dios*,
 My life will be thine, heavens of love.

¡ Ay Zandunga!
 Que Zandunga, amor sublime, *mama por Dios*,
 Zandunga, por lihi gaté,
 Huerita de mi corazón.

Aye, Zandunga!
 Zandunga, love sublime, *mama por Dios*;
 Zandunga, for thee will I die,
 Mistress of my heart.*

*Zandunga por tí llorando, mama por Dios,
 ¿Dónde vives, cielos de amor?
 En busca tuya ando, mama por Dios;
 Tu amor me esta matando, cielos de amor.

¡Ay Zanduuga!
 ¡Zandunga que mata, mama por Dios!
 Zandunga, no me matas,
 Prenda de mi corazón.

Zandunga, qué fin tendré, mamá por Dios,
 Si tú me desprecies, cielos de amor:
 Nací para ti, mama por Dios:
 Me lo dice el corazon, cielos de amor.

¡Ay Zandunga!
 ¡Zandunga, que da vida, mama por Dios!
 Zandunga damela á mí,
 Ángel de mi corazón.

Zandunga mientras yo vivo, mama por Dios:
 En tu casa cantaré, cielos de amor:
 Tu casa será la mía, mamá por Dios:
 Mi vida la tuya, cielos de amor.

¡Ay Zandunga!
 ¡Zandunga, amor sublime, mama por Dios!
 Zandunga por ti moriré,
 Huerita de mi corazón.

The Zapotec towns from San Geronimo to Tuxtla Gutierrez present much similarity. San Geronimo itself lies a little back from the Tehuantepec Railroad station of the same name; it spreads over a considerable area, which is swept clean and bare by strong, hot winds. The houses are rectangular, composed of poles daubed with mud and whitewashed, and roofed with high, steeply-pitched roofs. Pottery is there made from a blackish-gray clay: the material is broken up by mallets, mixed and shaped by hand into astonishingly large olla-like and plate-like forms. Single ollas are often lashed to carts and used, apparently, for hauling water.—The Zapotecs are expanding and crowding on the other native populations far down toward Tonalá and other parts of Chiapas. Juchitan is a veritable hive from which swarming is constant. Unión Hidalgo is a Juchitec colony. Ixhuatan was

a "made town," governmentally devised, for the purpose of drawing the Juaves of San Francisco Ixhuatan from their lagoon and fishing, to make of them staid agriculturists. The experiment failed and Zapotecs have crowded into the village until but four or five Juave families remain. The Zapotecs through this region call the Juaves "Juapes"—a name which these resent.—The Juchitecos whom we met are large, strong fellows: many of them, if not all, still wear the ancient breech-clout of red cloth underneath their usual clothing; even boys of twelve wear this under the little shirts, which are their only other garment.—A favorite food, not only among these Zapotecs but also among the Chiapas tribes, is *posole*. This, hereabouts, is a mass of wet-ground maize mixed with *pancha* (brown sugar). It is extremely condensed nourishment. Among Tzendals and Chols it has no sugar mixed with it, is white, and is kept moist by wrapping in banana leaves. Here it is dry, and of a brown or yellowish color from the admixture of sugar.—Characteristic of this region are *tortillas del horno* (uā nā sū-kí) or baked tortillas. *Tortillas* about the size of a fruit plate are shaped in the usual way. An *olla* is sunk in the ground until the rim is just even with the surface: it is covered with a *comal* (flat, round griddle) or another *olla*: a good fire of coals is made in it. The *tortillas* are then placed in, stuck about the inside of the *olla*, and left to bake. When taken out they are crisp and, in the baking, have assumed the form of a saucer, by the turning up of the border.—At Ixhuatan we found some curious toys of crude pottery, which are made at Juchitan and sold as presents to be given at New Year. The forms include saucers, bowls, etc., and quaint figures. Among these, representations of women with babies are ethnologically interesting as showing the way in which children are carried astride the hips and that two nursing babies may be carried at the same time—weaning being delayed. (Figs. 30, 31.)

THE ZOQUES.

The relation of the Zoque language to the Mixe has been well established and the two tribes are usually grouped into a Zoque-Mixe family. The student who has best studied language and people on the spot is Dr. Berendt, who spent some time at Tuxtla Gutierrez. Orozco y Berra says the *Zoque*, *Zoc*, *Soque*, language is spoken in Tabasco, Chiapas and Oaxaca. We visited this people only at Tuxtla Gutierrez, capital city of Chiapas. At that town, the Indian part of the

population is all of this speech, but shows a considerable admixture of Spanish blood.

The physical type does not appear to be well defined. In men the color is rather light: the eyes are rarely oblique and are widely spaced; the bridge of the nose, in youth straight or even concave, becomes notably aquiline with age; the upper lip frequently protrudes beyond the lower; the lower part of the face is, often, broad; an *apparent* arocephaly is not uncommon. Women are, usually, asymmetrical, one shoulder being much higher than the other.—The disease called *pinto*, or *tinta*, is common: blue or purple appears most frequently but it is often associated with white.—Babies are carried in a strip of cloth, tied over one shoulder. The child is slung in this in front of the mother, with one foot before and the other behind the mother's body. It is *said* that the practice is to carry the babe on the back, but we saw nothing of it. We are inclined to attribute the notable asymmetry already mentioned to this awkward mode of carrying children.—The Indian houses are far more characteristic than would be expected in a city, where so many *mestizos* live. Several structures are usually grouped together in one enclosure. (Supl. Pl. liii, liv.) The largest usually backs upon the street and stands at the corner of the yard. It is substantially built, with thick walls, and tiled roof. The walls are plastered externally and smoothly finished with mud internally. The exterior of the wall may be divided, by the timbering, into round-hollowed panels; the plastering may be tinted or white, and upon a white foundation color streaks may be decoratively daubed. The base is often banked up with a slope of mud or stones. A small cross usually rises from the middle of the roof ridge. The front roof often projects over a porch, which is walled up at the sides and open in front. A screen of canes may partly enclose the front. This house corresponds to the *teopant-zintli* (god-house) of the Tlaxcalans and Aztecs. The Zoque cook-house (= Aztec *tecacalli*) is less elaborate; the walls are of daubed poles, the roof of thatch; the door of canes, set and tied transversely, rolls up. The granary (= Aztec *cencalli*) is built on supporting stakes and is sheltered by a doubly-sloping thatch which extends beyond it and is supported by independent poles and cross-sticks.—In the cook-house, on the floor near the rear, a small oven is constructed; it is no more than fifty centimetres long and its height and breadth are less; it is oval or elliptical, and looks like a huge limpet or an armadillo shell attached to the floor. A pottery plate covers its opening. A

curious bread is baked in this oven. It is made of corn, beans and shrimps; the mixture is shaped into a *tortilla*, which is then laid upon a large leaf; these are then rolled up and the whole is baked; the leaf imparts a sort of aromatic flavor.—The dress of women is characteristic, and consists of three pieces. The *iscahuipil*, of cotton, is rarely worn, but is usually folded into a flat pad and laid upon the head; the material is home-woven, and consists of alternately close and open bands. This garment is slightly larger than the true *huipil* and is neatly decorated with vertical lines of silk stitching, which divide it into fairly equal sections, and with silk stitching at the neck and arm-slits; these openings may also be bordered with lace. At mass, this garment is so worn that the neck fringe of lace borders the face, as with the Tehuantepec women. The *huipil*, made of similar stuff, is smaller and is worn as the ordinary upper body garment; the neck opening is cut rather low and is bordered with black; the arm-slits are bordered by a pleated border of cotton, the outer edge of which is worked with black designs. (Fig. 34.) The *chincuey*, *enagua*, or *costal*, is made of two strips of indigo-dyed cotton, perhaps a *vara* wide; these are laid side by side and prettily stitched with colored silks; the free ends are then sewed together and decorated with colored stitching; these strips may be two metres in length. No belt is used in fastening this garment around the body; the open bag is gathered about the waist, the surplus is folded in front, and the overlapping end is tucked in; this is so done as to leave a pouch or pocket, in which articles may be carried. (Supl. Pl. lv.)—Besides the usual Indian agriculture, the Zoques have some industry in henequin, they weave cotton *enaguas* and *huipilis* for sale, and they make some pottery. The women shred out the henequin at home; the weaving of it into *riatas*, *costales*, *arganas* (halters, sacks, saddle-bags), etc., is the work of men, although the manner of weaving is exactly that of the woman in cloth making. (Fig. 33.)—An excellent red ware is made by Indian potters at Don Rodriguez. It is shaped into *ollas*, into neat censers of double goblet form, with three little birds, perched about the upper rim, etc.—Clumsy bird-cages are to be seen at many houses. They are flat-bottomed, square-ended, semi-cylindrical-topped forms, made of sticks and strings, which are hung by cords, from and under the far-projecting roofs. (Fig. 32.)—There are many persons who treat disease. They especially treat *asustados* (frightened persons.) After feeling the pulse, they tell the patient how he has been frightened—

by water, or fire, or some animal: these diagnoses are said to often be correct. They then take *aguardiente*, *romero* and maize into the mouth and suck portions of the patient's body—the elbow-fold, the hand, finger-tips, head, etc.; they then again take *aguardiente* into the mouth and spray it over the patient's head and face, which they then cover with a cloth. This treatment is pursued daily, the cure finally taking place on the ninth or the eighteenth day —A physician, graduated at the City of Mexico, tells me that the Indians here have knowledge of secret remedies, which is transmitted from father to son. He knew a man who had a remedy for *pinto*. The substance was probably vegetal: it was scraped or shredded, and applied directly to the spots, with almost immediate effect. The old man charged one price to all, rich and poor—and that was only two *reales*. Efforts were made, in vain, to learn his secret: the old man was not moved by an offer of thousands of *pesos*, nor by threats of shooting. He died shortly after, carrying his secret with him to his grave. — Love songs exist in the Zoque language; parties of young fellows go out to serenade, with instrument and singing, at the windows of the sweet-hearts. For weddings, special garments are used, but are rarely the property of the contracting parties, being rented for the occasion. M. F. Fernandez, of Merida, Yucatan, who speaks only as a traveler, though a good observer, says that at Tuxtla Gutierrez the bride, who is a virgin, carries a garland of flowers to church, at the mass next before the day of her wedding: no one, not entitled to do this, would dare attempt it. He considers the custom a distinct aid to morality. — —Through a large part of Chiapas, as in Guatemala, there are two sets of officials, in towns where there are many *mestizos* and also many Indians. Thus, at Tuxtla Gutierrez we have two *municipalities*, the *mestizo* officials and the “Indian *alcaldes*.” These are easily recognized, as they officially retain the ancient style of dress—small, short, loose *camisas* of home-spun cotton, wide drawers of the same material, and short over-drawers of leather, with decorative work upon the down-turned pocket-flaps. They wear broad-brimmed hats, under which are head-cloths; the latter are left on, when the hats are removed and carried under the arm. (Supl. Pl. lviii a.) After serving as Indian *alcalde*, a man wears this head-cloth as evidence of that service. The Indian *alcaldes* form the *guardia del Santo Intierro*. On Holy Thursday and Good Friday they stand on guard at the holy sepulchre with crosses, especial to the occasion, in their hands.— Writers state that the Zoques are little influenced by emotions of

friendship, and that even blood relationship is little esteemed. They have, however, great respect for the artificial relationship of *compadres*. One of the notable customs is the displaying of elaborate respect between *compadres* when they meet. (Supl. Pl. lix b.) A special formula of words, and definite rules regarding the removal of hats, bowing, etc., are followed.—Among popular *danzas* is the *Baile del Carnaval* or the *Baile de San José*. This was performed for our benefit. Music is supplied by violin, *pitos* and drum. The *pitos* are small, cane pipes, of two kinds. The smaller has slant-cut mouth-piece, partly plugged with gum, a square hole near the end and two similar holes opposite. The larger is longer, and has a similar mouth-piece, one round escape hole on one side, and several on the opposite side. The drum is a hollow cylinder, cut from a block of wood, with both ends covered with stretched skins, which are tightened by cord lacings, passing from one to the other, back and forth. The dancers are fantastically dressed. (Supl. Pl. lvi, lviii b, lix a.) Four dancers participated in the rendition given us—the leader, a little girl, a man dressed as a woman, and a young woman. The leader and the little girl (who carried a *jicara* full of pink “flowers of the carnival”), faced each other, dancing sedately, moving slowly back and forth, and from one foot to the other. The others carried bent sticks, presumably representing battle-axes, and danced in much the same manner, though with more freedom and life, circling around the leader and his companion.—At Corpus (in June), they dance the *Baile de la Malinche*. There are two chief dancers, a man and the *Malinche*; there are other dancers who perform the *Baile de fierro*. Those who, in this represent Spaniards, wear spurs. Unfortunately, we did not secure a clear account of this.—In every *tecopantzinli*, there is, opposite the door and built against the rear wall, a neat altar table, smoothly finished with clay. Upon it stands a *santito* and offerings of flowers, candles, incense, etc. Above this household altar are usually to be seen four ears of corn of different colors. The three common colors are *blandita* (white), *colorado* (red)—a rich crimson, and *sangre de Cristo* (blood of Christ)—a yellow, with red stains; usually the fourth is *negro* (black.) These ears may be arranged radiatingly, as a cross, or side by side. They have been blessed by the priest, and are later to be used as seed corn, to ensure good crops.—In one group of houses we visited, there was a pretty *hermita*; it was neatly plastered and white-washed outside; the two-pitched tile roof was surmounted by a little cross; an altar, within

supported a dark Christ, dressed in a white gown and carrying a St. Francis' cord. The altar was covered with a white cloth, embroidered with red designs. Two or three censers were in the room and a little drum hung in one corner; this is used to summon the group of persons interested in the *hermita*, to their gatherings. Such buildings play a curious part in the life of some tribes. Here, they denied their use as burial places.—In their feast of the dead here, they set plates of food and bowls of chocolate upon the bare floor, and cover them with a heap of flowers. They then withdraw, leaving the house for the night to the dead. The next day, returning, they open the heap and eat the viands.

THE CHIAPANEC.

When Orozco y Berra wrote his *Geografía de las lenguas*, only three towns in Chiapas still used the ancient Chiapanec language—Chiapa, Suchiapa, and Acala. Tradition asserts the past importance of the Chiapanecs. The relationships of the language have been considerably discussed. Perhaps Berendt, Charency, and Sapper agree in affiliating it with the Nahuatl. Orozco, in this connection, says: "So that, if the Chiapanecs and Mexicans (Aztecs) are not of one family they drank in their culture from a common fount * * ." They are said to have computed time in the same manner as the Aztecs, although employing different symbols for representing the years, months and days, and to have used a similar mode of writing. Today the language is practically dead. A few old people, especially in Suchiapa, are said to know the meanings of the old words.

The town of Chiapa is located upon the Mescalapa River, where there is a ferry, the boats being great canoes hollowed from single tree trunks. The population is largely *mestizo*. The town is famous for its lacquer work, which goes to Tehuantepec on one side and the Gulf of Mexico on the other. Chiapa vendors carry the articles into Vera Cruz and Tabasco, where they are called *sitones*, and into Guatemala, where they are known by the name *bush*. In Chiapa itself they are called *jicalpextli* (the large bowls) and *chinchin* (the rattles). Figs. 38, 39, 40, 41.) In 1896 we visited a house where this work was being made: five women were painting gourd toys. A white earth, gathered between Tuxtla Gutierrez and here, is used to make the color adhere. Paints are bought in bulk at Tuxtla Gutierrez and ground with a fine-grained pebble upon a stone slab. A waxy mass, *aje*,

rough and reddish brown on the outside, and chrome yellow within, is used as a medium. The gourds are first rubbed with the white earth; the earth, color and *aje* are mixed between stones; the mixture is applied to the gourd and rubbed by hand; the gourd is then rubbed upon a cotton pad lying upon the knees of the operator; the final lustre is developed by rubbing with a tuft of cotton. Floral and other designs are painted on the colored gourd with a free brush.—Much *aje* is prepared at the Tzotzil town of San Bartolomé. The insect from which it is made is a species of *coccus*, which lives upon the *timbre* and the *espino negro*, two trees of the *leguminosæ*. The insects are found only from May to August; when they first appear, at the beginning of the rainy season, they are small—almost invisible; they grow to the size of a large tick, but are narrower; they are of a fiery red color, but secrete a whitish substance which covers them. These insects swarm in such masses that the branches and trunks are white with them. They are brushed off into vessels and washed until the white disappears; the mass is then boiled, crushed, and squeezed in a cloth; the oily matter strains out; it is then boiled to drive out water, and washed several times in trays to remove blood, after which it is made up into balls. It sells at twelve centavos a pound.—For the use of *aje* in somewhat similar lacquer-work by the Tarascans, see *Part I* of these *Notes*, p. 13.—Pottery is said to be made in Chiapa and Suchiapa but we do not know the ware.—In the January *fiesta*, which is said to last fifteen days, pretty round rattles of lacquer-work (Fig. 41) are used by the dancers. Three days in this *fiesta* are of especial importance, San Sebastian, San Antonio Esquipula, San Antonio Abad. On these days, as many as two hundred persons, all with rattles, participate in the dancing. There appear to be no words in this dance, but in the dance called *calali*, there is dialogue in the old Chiapanec language. This dance takes place during carnival season, and among the dancers are the *calali*, the *tigre* (tiger), and the *venado* (deer.)

THE TZOTZILS.

Linguistically, the Tzotzil and Tzendal are closely related, and belong to the great Maya family. Orozco y Berra inclined to derive both from the ancient, and now extinct, *Queleues*. Both languages are confined to the state of Chiapas. Padre José Maria Sanchez, of San Cristobal, is a diligent student of Zoque, Tzotzil and Tzendal, and has labored faithfully among these tribes as priest. His *Nomen-*

*clatura** is a useful chart, linguistically locating the towns of the state. He called our attention to some interesting laws of permutation between the Tzotzil and Tzendal; thus:

Tzotzil: *ō ī m* final, become in

Tzendal: *ā ě b* final,

and *vice versa*. For example—Tzotzil *tzim* appears in Tzendal as *tzēb*. In both languages, they are prone to add, for elegance, the termination *al, el, il, ol, ul* to words; in making these additions, the termination chosen agrees with the main vowel of the modified word; for example, *jol* (head) becomes, in elegant speech, *jolol*; *eschil* (brother) becomes *eschilel*, etc.

The Tzotzils of Chamula are those among whom we worked, although we did not visit their village; we met them at San Cristobal. It was these Chamula Indians who, in 1869, led a notable insurrection. The soul of the enterprise was an inspired priestess—Agustina Gómez Checheb. The plan was to kill all the whites and *mestizos*, to restore idolatry, and to regain independence. Idolatry was re-established, an Indian boy was crucified as a mediator, and more than one hundred whites and *mestizos* were killed. The same spirit now exists, and yet—if we may judge by the list of charges now against Chamula prisoners in the jail at San Cristobal—finds an outlet, from time to time.—The Chamula type appears fairly marked. The head is large; the face large and coarse featured; lips thick, though not notably projecting; stature greater than in the Tzendals; color, rather light.—Even their mestizo enemies admit the phenomenal industry of the Chamula Indians. They are great weavers of wool, and their heavy *chamaras* and *fajas* go to their neighbors for many leagues around; they make quantities of plain and simple furniture; they fabricate violins, harps and guitars, upon which they delight to perform, and for which they find a ready sale; they manufacture large numbers of round boxes of thin wood, like pill boxes; they dress leather excellently, and their staining and polishing of heavy black leather surpasses the work done by *mestizos* at San Cristobal; they braid palm hats, and decorative bands of straw with which to adorn them. (Fig. 36.)—Tzotzil dress varies with the town. At Chamula, men wear heavy, black, woolen *chamaras* (blankets, with neck-lit) and white woolen *camisas*, or jackets, and drawers; their hats are broad-brimmed and low-crowned—the crown ending with a low

* Nomenclatura de los Once Departamentos de Chiapas. San Cristobal: 1890.

conical projection, often in two colors, white and black; gay ribbons—usually green and red—decorate the hats; sandals, of heavy leather, have a heel guard of strong, handsomely polished, black leather, the height of which indicates the wealth or importance of the wearer. (Supl. Pl. lxiv a, lxvi a. Also Figs. 35, 37.) Women often wear two heavy, black, woolen garments, each of a single piece, reaching to below the knees: from the middle of the breast in front, and from a corresponding point behind, hangs a tuft or tassel of red; a plain woolen belt girds the body around the under of the two garments. (Supl. Pl. lxv.) Men of Huixtan wear *little* hats, with flat brim and low flat crown: this they perch upon the top of the head; their *camisas* and drawers are of coarse home-spun cotton, decorated with a line of blue stitching. (Supl. Pl. lxiii.) Men from San Felipe wear white, woolen *chamaras*, which are short behind and long in front, with narrow stripes of red, yellow or black, which intersect, forming a coarse checking; they wear wide, cotton drawers and ordinary palm *sombreros*. Men of San Bartolomé wear *little* *camisas* and wide drawers of home-spun cotton, into which bird, animal, human and geometrical patterns are woven with bits of bright colored worsteds.—We observed no cases of *pinto* among the Chamula Indians whom we measured; the disease is common at San Bartolomé.—In counting, the Indians assist themselves by touching the fingers of one hand, with the index finger of the other hand; thus, *one* is counted on the little finger of the left hand, *two* corresponds to the next finger, *five* is the left thumb, *six* the right thumb, and *ten* is the little finger of the right hand.

THE TZENDALS.

The name of this tribe is variously written *Tzendal*, *Zendal*, *Cendal*, *Tzeltal*, *Celdala*, *Celtala*. Of the various pueblos visited Tenejapa (Supl. Pl. lxx) and Cancuc were assumed to be typical. The latter was the centre of the famous insurrection of 1712, an insurrection in many respects similar to the already mentioned Chamula outbreak of 1869. The heart of this insurrection was also an inspired priestess, *Maria Candelaria*. Dr. Brinton makes this insurrection the subject of his drama, named after the priestess.—The Tzendals are shorter than the Tzotzils and much darker; their heads, though smaller than those of the Tzotzils, are actually large; the maximum head-breadth and face-breadth are often the same; the lips are thick and projecting

and the face is often prognathic; the ears are usually close to the head, while those of the Tzotzils frequently project.——When at rest, they assume one of two attitudes: they either squat and throw the weight of the body forward onto the ball of the foot (Supl. Pl. lxi b.) or they sit squarely on the ground with their legs stretched straight in front of them.——Their hair is usually long and tangled and hangs so as to conceal the ears. To explain this, two *apparently* historical reasons are offered. It is said that after the Indians had been defeated in one of their past insurrections, the white conquerors cut off the ears of the vanquished: to hide this deformity they wore their hair long and over the place of the ears, which custom is continued. In the old church at Cancuc is a much prized painting; it represents a priest who aided in quelling the outbreak of 1712. In the picture his hair is drawn down so as to cover his ears: it is claimed that the veneration of the Indians for him was so great that they have ever since worn their hair after the same fashion. The curious point of agreement in these stories is that both locate the date of adopting the practice, after a revolution.——Few wear hats; such as are worn are of the Chamula type. Most men of Tenejapa wear Chamula *chamaras* of vertically striped black and white wool (Fig. 42); *camisas* and drawers are made of cotton stuffs bought at San Cristobal; the drawers are wide, but short, not reaching the knees; the *chamaras* usually reach down below the drawers; sandals are simple, without heel-guards; the belts worn are not of their own weaving. While at Tenejapa the long, heavy, black *chamaras* are rare, they are the rule at Cancuc. At Cancuc all men wear the breech-clout and, when carrying burdens in the daytime, wear little else; *camisas* are of native woven cotton, with a little decorative stitching at the neck and where the edges of the piece of cloth unite; this hangs, when girded, just to the bottom of the wide-legged, cotton, drawers. Girdles at Cancuc are of local weaving, and are made of cotton thread which is bought ready-dyed; through the red texture run narrow lines of yellow. At Tenejapa, older men sometimes wear a broad sash of black woolen stuff, across the breast, with the ends, hanging down the back behind, decorated for a foot or so with brilliant and solid color decoration. (Supl. Pl. lxxix b.) At Tenejapa, the women wear short *huipils* of cotton, decorated with separated designs, geometrical or animal, loosely arranged in transverse bands; the *enaguas* are dull blue, with narrow lines of red or yellow decorative stitching; belts are of white wool, or red, but are made at Chamula; over the shoulders, in cool

weather, the women wear a shawl or wrap, which is coarsely and broadly striped in red and blue. Women wrap their braids of hair around and around with red cords or strings, until they look like red ropes, which they then coil about the head. (Supl. Pl. lxxv.) The Cancuc women wear rather long *huipils*, of home-weaving, with little attempt at decoration; their dull blue *enaguas* are quite as plain; their *fajas*, or belts, are mostly of wool, from Chamula. —In the market at San Cristobal, we saw the women from San Andres wearing characteristic *huipils*, the breasts of which were a solid mass of heavy embroidery. (Figs. 43, 44, 45.) At Cancuc, the houses (Supl. Pl. lxxvii.) are mostly built on slopes; stone foundations are therefore laid, to give a level surface for building; the walls are of poles, lashed horizontally to vertical supporting posts, and daubed over with dark *adobe* mixed with pine needles; the thatch is of *zacate*, well laid, and carefully trimmed at the lower edge. Roofs are often surmounted by a rectangular, carefully trimmed, crest-comb of thatch, upon which a line of potsherds is laid. Every house has its pig-pen, and most have a *temascal*; both of these are neatly thatched. —At Ixtapa, they make salt, from the salt-impregnated soil; this is made up into large cylindrical loaves, shaped in *petates* (rush mats), the impression of which they show upon their surface. These are cut up with saws, as sold in the market. —The Indians of Tenejapa raise and sell fruit —oranges, *limas* and *ahuacates*. Those of Cancuc raise pigs. At Tenango, they make pottery. Small sacks of pita are widely used, and are of local manufacture. (Fig. 46.) —The pottery from Tenango is well made and is widely sold. The ware is fine grained and well baked; it is made chiefly in large *jarras* (jars), egg-shaped, with three loops for carrying straps or cords; they are of a yellowish-brown color, with decorations in darker brown, or in black; these decorations are conventionalized, and some may be derived from originally animal forms. These great *jarras* are especially used for carrying *chicha*. (Figs. 48, 49.) —Chicha is a fermented drink, made from the sap of sugar-cane, which is much in vogue from here southward into Guatemala; it tastes something like apple cider and is cheap—a great mug full for a *centavo*. —Tzendals, on the road, carry a little gourd or calabash of *mai*; (Fig. 47) this is powdered green tobacco, mixed with lime and *chili*; it is dipped with a little stick and chewed or sucked, “to strengthen the teeth.” It is probably stimulant, and enables one to withstand the fatigue of the road. It is also called *pilico*, and is, no doubt, the *pisiote* of the Mazatecs.

(See Part I, p. 78.) *Posol* is carried by Indians traveling on foot; the moist mass is kept fresh in banana leaves; at the brookside a *jicara* of water is dipped, and a handful of *posol* squeezed up in it; here it has no sugar mixed with it, is white, and has a slightly sour taste, as if beginning to ferment.—At Cancuc, they have three primitive musical instruments (a) the *tambor*, cylindrical drum, covered at both ends with skin (Fig. 50); (b) *pito*, with two note-holes; *tortuga* (turtle), the great shell of a tortoise, beaten with the leg-bone of a deer. The shell is not artificially modified, except that a notch is worn at one place by the carrying strap or cord. (Fig. 51, Supl. Pl. lxxiv.) —Padre Sanchez tells us that the old calendar of eighteen months of twenty days each, with five added days to complete the year, is still in common use here. He says the intercalation of the five days takes place at Holy Week. His explanation is not clear, but we present the list of months, and the correspondence of these with our calendar, as he gives them:

Chiapas: Calendar, which the Tzotzil Indians still use: 1901.

From	January 1 to January 20 is.....	Tzim.
	January 21 to February 10.....	Batzul.
	February 11 to end of February....	Sisác.
	March 1 to March 20.....	Muctasái.
	March 21 to April 10.....	Móc.
	April 11 to end of April.....	Olalti.
	May 1 to May 20.....	Ulol.
	May 21 to June 10.....	Oquin-ajual.
	June 11 to end of June.....	Uch.
	July 1 to July 20.....	Elech.
	July 21 to August 10.....	Nich-quin.
	August 11 to end of August.....	Sba-vinquil.
	September 1 to September 20.....	Schibal-vinquil.
	September 21 to October 10.....	Yoshibal-vinquil.
	October 11 to end of October.....	Chanim-vinquil.
	November 1 to November 20.....	Póm.
	November 21 to December 10.....	Yashquin.
	December 11 to end of December...	Mush.
	Holy week: Cushel. Carnival: Tajamul.	

Much of interest could be learned at Cancuc regarding religious ideas and superstitious practices. In the church the natives repeat prayers in the native tongue.

THE CHOLS.

Chols live in two separated masses: one in Chiapas, the other in the Vera Paz, of Guatemala. The Chol towns of Chiapas have been sadly broken by the demand for laborers made by neighboring *fincas* (plantations.) Their villages are Tila, Tumbalá, Petalcingo, Hidalgo, Trinidad, San Pedro Sabanta, La Libertad and Junchilpa. At Palenke and El Salto, a part of the population is Chol. More than a hundred Chols are on the *fincas* of El Triunfo and El Porvenir. In the Cerro D n Juan, are independent Chols, who have fled thither to escape contract labor and contributions: they are there quite safe, as there are no roads by which to pursue them. Within recent years, some three or four hundred Chols have removed into the state of Tabasco, to escape contract labor. Some Chols also live in the border district, between Simojovel and Palenke. This information regarding Chol distribution we owe largely to Mr. Henry Rau, of El Triunfo. To him, also, we are indebted for other data regarding this interesting people.—There are three dialects of the Chol in Chiapas, corresponding to the three once important towns—Tumbalá, Tila and Petalcingo; the two last are affected by a considerable introduction of Tzendal words. These dialects persist, and serve to determine the origin of the smaller towns of the Chols; thus, Hidalgo is a colony of Tumbalá.—We visited Chols at Hidalgo, Tumbalá (now practically deserted), El Triunfo and Trinidad. Hidalgo is prettily located in a little flat valley, at the edge of a pretty stream. —The men of Tumbalá can be generally recognized by their *cotones* and their hair-cut. The *cotones* are made of home-woven cotton, which is white, with vertical stripes of pink; the hair is so cut that that on the forward part of the head is longer than that behind, and hangs down over the forehead as a bang or fringe.—Señor Rau tells us that the Chols have nick-names, by which they are commonly called, and which they place after the other two names. Among these nick-names are *sanate* (a sort of bird), *tusere* (hunter of moles—*tusa*), *cucaracha*, *paloma*, *jefe*, *pajarito*, *chipilin*, *raton*, *conejo*, *venado*, *ardilla*. We do not understand whence these names came; they are mostly, or all, Spanish; they may truly be "nick-names." Señor Rau also says that the Tzendals have nick-names, but in their own language. We met such in Tenejapa: there men regularly give three names, two of which are Spanish, the last native. There, we feel sure that these are *not* nick-names, but the old family names still

preserved.—The Chols are accustomed to bury dead children under the floor of their hut; though it is against the law, and against the rules at El Triunfo, they persist in the practice.—In Appendix II will be found a Chol vocabulary, which has been made by Señor Rau for practical purposes at El Triunfo. He first prepared the list of words which he deemed advisable, and then secured the Chol equivalents. We present the whole list, though many words appear to have no Chol equivalent. To us, these gaps appear suggestive, in their ethnic and psychic information.

THE LACANDONS.

We regretted not visiting the Lacandons, as we passed so near their territory. Time was lacking for the visit, and it would have been difficult to subject their scattered population, without settled villages, to our purpose of measurement. We only refer to their well-known practice of making stone-tipped arrows, of which, and a bow, we give an illustration. (Fig. 52.) It is doubtful whether these have much significance in the actual life of the Lacandons. It is quite possible that they are made more as curiosities and for sale, than for actual use.

NOTE.—In this paper, the references are as follows: *Supl.* is Part II of the author's *Indians of Southern Mexico*, soon to be published. *Figs.* referred to are those accompanying the present paper.

APPENDIX I.

AZTEC VOCABULARY MADE BY AN INDIAN BOY OF CITLALTEPEC, STATE OF VERA CRUZ, FOR THE CURA OF TANTIMA.

Como la pasao bien: Are you well?

Quen ti panotica cuali.

Pase entrarse: Enter.

Hĩ hasi hicalaquĩ.

Bengo à visitar à Ud. sr. I come to visit you, sir.

De donde heres: From whence are you?

Campa mocha.

Yo soy de San Nicolas: I am of San Nicolas.

Nano haltepe San Nicolas.

Hora en las frutas: Now, in fruits.

Quiero comer naranja: I wish to eat an orange.

Ninequi nicuas lalax.

Lima—lima—lima.

Platano—banana—cuahilotc.

Jicama—jicama—cazol.

Camote—camote—camotli.

Elote—bean—clolcot.

Haguacate—aguacate—huaguacal.

Caña—sugar-cane—hugualtx.

Quiero una cosa dulce : I want something sweet.

Ninequi cosa tlen zopelic.

Tortilla—corn-bread—talhcali.

Carne—meat—nacal.

Queso—cheese—queso.

¿Y tiene ud. gusto de encontrar el matrimonio con esta muchacha?

And do you desire to marry this girl?

Yguan tipia mupaquilio ti mo namix tis iguani il pocal.

¿Y tiene ud. gusto de encontrar el matrimonio con este muchacho?

And do you wish to marry this boy?

Y guanta tipia mupaquilis timonamixtis iguanni telpocal.

¿Cuanto vale el maíz? How much is corn worth?

¿Guen ipati sintlil?

Pilon—loaf of sugar—chancaca.

Esta—this—ni.

Gallina—hen—siguafillo.

Puerco—pig—pisotto.

Pollo—chicken—polloch.

Gato—cat—misto.

¿Que tanto, quieres per esta su caballo?

How much do you want for your horse?

¿Guesqui tinequi ni mocaballo?

¿Que tanto vas á dar per su casa?

How much are you going to pay for your house?

¿Guesqui ica ti caguas mucha?

¿Que tanto pides por su solar?

How much do you ask for your lot?

¿Guesqui tittalani ica musolar?

¿Que tanto me das por este sombrero?

How much will you give me for this hat?

¿Guesqui tintomacas ni sombrero?

¿Que tanto quieres por su libro?
How much do you care for your book?

¿Guesqui tinequi ica molibro?

¿Que tanto me pagas?
How much will you pay me?

¿Guesqui tineh talhtalguis?

Regalame tantita agua.

Give me a little water.

Meh tlayocoli achi attax.

Da me de comer.

Give me something to eat.

Meh maca nitalcuas.

Que gusto me dio.

What joy it gave me.

Gue neh pactique.

Mucho me agrada.

Much it pleases me.

Chaneyano neh pactiqui.

Vien gisado. Welcome.

Cuali clachichiguali.

Vien zalas. Godspeed.

Cuali histallo.

¿No le falta nada?

Nothing is lacking?

Axtlen qui poloa.

Acalentar comida.

Heat up the dinner.

Titonise tlalcuali.

¿Como tellamas?

What is your name?

¿Claque mutoca?

¿Donde vienes?

Whence come you?

¿Campa tiguala?

¿Que dice su corazon?

What does your heart say?

¿Clen qui y togua mulloto!

¿Que estas pensando?

What are you thinking?

¿Clen ti pensarogua?

¿Vas á comprar?

Are you going to buy?

¿Ti tlalcuali?

¿Cuando vas para su tierra?

When do you go home?

¿Guen man tillas ica mucha?

¿Cuántas días de camino?

How many days' journey (is it)?

¿Guesqui tonati quipia hotlil?

¿Aquí á Tantima y San Nicolas que tanto leguas tiene?

From here to Tantima and San Nicolas, how many leagues?

¿Nica Tantima y guan San Nicolas quesqui legua quipia?

Manana salgo para Tampico.

Tomorrow I leave for Tampico.

Mustal niquisa para Tampico.

Y de Tampico voy para Vitoria en el tren.

And from Tampico I go to Vitoria in the train.

Yguan Tampico nilla para Vitoria y pan tren.

Voy con la carga.

I go with the cargo.

Yguan milla y ca carga,

Llevo venta.

I carry something to sell.

Niguica thalnamaquistli.

Cosa buena.

Something good.

Cosa tlen cuali.

Names of trees or woods:

Palo de naranja.

Orange tree (or wood).

Lalax cuaguite.

Jovo—cuaxoen.

Mirasol—tiocuela.

Horejon—nacas.

Lava traño—nextamal.

Guallava—*chalhocol*.
Sedro—*giocuaguittic*.
Seiba—*pochole*.
Candelio—*macpil hxochil*.
Rosa—*hxochicualtic*.

Names of animals:

Venao—*masaltalc*.
Ardilla—*tococin*.
Armadillo—*aytochi*.
Mapachi—*mapachi*.
Tigre—*tecuaní*.
Tigrilla—*cuamecale*.
Leon—*masatecuani*.
Culebra—*hocuilin*.
Voladura—*apachi cugual*.
Qulebra negro—*ctilt gugual*.
Cuatro narices—*maguaquili*.
Masacuale—*masaqual*.
Collote—*collote*.
Jabalin—*simaron pizotole*.
Tejon—*pesottil*.
Perro—*chichi*.
Gato—*miston*.
Nusa—*sacamislei*.
Pajaro—*guilole*.
Tordo—*sana*.
Papame—*papame*.
Cholinchi—*pihpih*.
Guajolote—*totoli*.
Gallo—*cuapeleh*.

Data for knowing the earth:

Cerro—mountain—*tepele*.
Tierra—land—*clalli*.
Piedra—stone—*tetele*.
La rollo grande—the great gorge—*guelliala*.
Que cosa—what thing—*claquia*.
Palo—tree, wood,—*cuaguille*.
Vejuco—vine—*mecalc*.
La ladera—the slope—*tepehil*.

La subida—the ascent — *claluecapan*.

La vajada—the descent—*cla haxcapan*.

Me sube—I climb—*niclelcos*.

Bajate—descend (imperative)—*chictemo*.

Numbers for counting:

Uno—*se*.

Dos—*ome*.

Tres—*elli*.

Cuatro—*nagui*.

Sinco—*macuili*.

Ceis—*chicuase*.

Siete—*chicome*.

Ocho—*chicuelli*.

Nueve—*chichagui*.

Diez—*maclaccli*.

Once—eleven—*yguance*.

Doce—twelve—*yguanome*.

Trece—thirteen—*maclaciliyguamelli*.

Catorce—fourteen—*yguan naqui*.

Quince—fifteen—*yguan macuili*.

Diez y seis—sixteen—*yguan chicuase*.

Diez y siete—seventeen—*yguan chicome*.

Diez y ocho—eighteen—*yguan chicuelli*.

Diez y nueve—nineteen—*yguan chichagui*.

Veinte—twenty—*sempuali*.

Veinte y uno—twenty-one—*sempuali iguan se*.

Vente dos—twenty-two—*sempuali iguan ome*.

Vente tres—twenty-three—*sempuali iguan hey*.

Vente cuatro—twenty-four—*sempuali iguan naqui*.

Vente sinco—twenty-five—*sempuali iguan macuili*.

Veinte ceis—twenty-six—*sempuali iguan chicuase*.

Veinte ciete—twenty-seven—*sempuali iguan chicome*.

Veinte ocho—twenty-eight—*sempuali iguan chicuey*.

Veinte y nueve—twenty-nine—*sempuali iguan chichagui*.

Treynta—thirty—*sempuali iguan maclaccli*.

Otro diez—another ten—*uni puali*.

Words connected with the harvest and the field:

Mais—indian corn—*sittcli*.

Blanco—white—*chipceguac*.

Amario—yellow—*cosetli*.
Amario—yellow—*maioj*.
Frijol—bean—*eettle*.
Picante—pepper—*chili*.
Llocas—*cuacamuetlic*.
Frijol de chivo—*chichimeca etlic*.
Frijol de mata—*nelecttec*.
Jicama—*cazocle*.
Xonacate—*xonacal*.
Calabaza—calabash—*ayoctitle*.
Camote—*camoctitic*.
Colandro—*colanta*.
Pipian—*piñan*.
Challote—*challoctlic*.
Malangua—*quequexquile*.
Jojolin—*ajolin*.
Tomate—tomato—*tomacle*.
Llerva buena—*alhueno*.
Hasafran—*hasafran*.
Algodon—cotton—*yhcal*.
Sandia—watermelon—*sandia*.
Melon—melon—*melon*.

When one speaks to you:

Te abla—he speaks to you—*ta misnonoza*.
Ami me abla—he speaks to me—*na neh nonoza*.
Le abla el otro—the other speaks to you—*qui nonoza nese*.
Le abla aquellos—speak to them—*nesequi quin nonoza*.
Nosotros—we—*taguanti*.
El otro—the other—*neselloc*.
Aquellos otros—those others—*nesequinoque*.
Hombre bueno—good man—*cuali clacal*.
Hombre malo—bad man—*haxenali clacal*.
Hombre embustero—boaster—*ystattcate*.
Hombre perverso—perverse man—*clacal pastic*.
Hombre que falta el sentido—man who lacks sense—*clacal haxclal namiqui*.
Hombre que tiene el sentido—man who has sense—*clacal clalnamiqui*.
Hombre laborioso—industrious man—*clacal tequipanna*.
Hombre que no trabajo—idle man—*clacal haxtequipanna*.
Hombre anda rieza—man irrigating—*clacal sannnenemi*.
¿Que dices?—what do you say?—*clen tiquitogua?*
¿Que me dices?—what do you say to me?—*clenque tinechilquia?*

Cuando—when—*quema*.

Haora—now—*ama*.

Entre un rato—soon; right away—*serrata*.

In the daytime:

Mañana—morning—*ynaloc*.

Á medio día—midday—*clacotona*.

En la tarde—afternoon—*clapollaqui*.

For knowing the necessary things in the house:

Metate—mealing stone—*mectalt*.

Jicara—gourd cup—*xhicali*.

Casuela—cooking pan—*chachapali*.

Cantaro—jar—*comile*.

Cuchara—spoon—*cuchara*.

Concerning what one feels in the body:

Estas alegre—are you happy (well)—*tipactoc*.

Estas triste—are you sad?—*titeguipachigui*?

Estas enfadado—are you vexed?—*ticuesigui*?

Estas enfermo—are you sick—*timococogua*?

Estas con la calentura—have you fever—*titotonilla*?

No puedes sanar—can you not cure—*haxgueli tipachigui*?

Te duele mucho—do you suffer much—*chanellano mixcoctua*?

Te duele sa cabeza—does your head pain you—*mixcoqua musontecan*?

Cuerpo—body—*muclacayo*.

Mano—hand—*moma*.

Barriga—stomach—*moiti*.

Pierna—leg—*momes*.

Pies—feet—*muiexhi paclaguic*.

Diente—tooth—*muclancopos*.

Oido—ear—*munacas*.

Ojos—eyes—*muichiz*.

No holles—do you not hear—*axti clacaqui*?

For knowing the sky:

La luna—the moon—*mesettititc*.

El sol—the sun—*tonati*.

Estrellas—stars—*sicttattlin*.

El viento—the wind—*ejecal*.

Nubes—clouds—*mixcli*.

El cielo raza—the clear sky—*claclanestoc*.

This little vocabulary is corrupt, in the spelling of both Aztec and Spanish words. Local peculiarities in grammar and pronunciation will be found in both languages. We give English equivalents for but few of the names of animals and plants, as the Spanish is usually transferred into our language. Where the Spanish and Aztec are alike, the borrowing is almost as likely to be from one side as from the other.

APPENDIX II.

CHOL VOCABULARY BY MR. HENRY RAU.

Abajo	lleval	down: below.
abeja	tschapp	bee.
abierto	jamulisch	opened.
abrir	jamún	to open.
abusar		to abuse.
acabar	tschaisch-uj-ti	to finish.
aceite		oil.
acceptar	tschu-mun	to accept.
acusar		to accuse.
adelantar		to advance: to forward.
adelante	zenún	forward.
adentro	ti'-mal	within.
adeudar	beet	to owe.
adonde	wakián	where.
aflojar	col-ló	to loosen.
afuera		outside.
agarrar	chu-kú	to seize.
agradable	uz-at	pleasant: agreeable.
agrio	paj	sour.
agua	ja	water.
aguantar		to suffice.
aguardiente	lembal	spirits: liquor.
agudo	amba aguchan.	sharp.
aguja		needle.
ahí		there.
ahora	gulé	now.
ahogar	muj yalel ti ya	to choke; to drown.
aire	i-k	air.
ageno	mach-chanik	strange.
alambre		wire.
alcanzar	muj-tía	to follow; to obtain.
alegre		gay.
algo		something.

algunos		some.
almorzar		to breakfast.
al rededor	ti jolloval	around about.
alto	chan	high.
amanecer	zuk-a	to dawn.
alli este	isch-aní	there it is.
amarillo		yellow.
amarrar	kut-schu	to fasten; to tie.
amigo	pi-ul	friend.
ancho mas	niúk	wider.
andar	cuai ti chumbal-che	to go; to walk.
anillo	amba mut ke bultche	ring.
animal		animal.
anteayer	uschil	day before yesterday.
antes	oni-yisch	before.
apagar	tiup-ú	to put out.
aparse	jubel	to alight.
año	jabil	year.
aprender	maku-nic	to learn.
aprovechar		to profit by; to improve.
apuntar		to note down.
arbol	tíel	tree.
arder	mi pulel	to burn.
arena	ji	sand.
arreglar	muj-mel	to arrange.
arriba	chan	up; above.
arroyo	pa	arroyo; gorge.
arroz	ujzil	rice.
asar	paj-pon	to roast.
asesinar	zun-zán	to assassinate.
asiento	butsch-lib	seat.
atar-atado		to tie; tied.
atras	jum-pat	behind.
ausente	mach-hua-on	absent.
ayer	ak-bi-ao	yesterday.
ayudar	kotian	to aid.
azucar		sugar.
azufre		sulphur.
azul		blue.
bailar		to dance.
bajo	pek-el	low.
bala		ball; bullet.
bañar	tz-ú-mel	to bathe.
baño		bath.
barato		cheap.
barba	lactz-uk-ti	beard.
barriga	lak-tnock	stomach.

barril.....		barrel.
bastante.....	ka-bul.....	sufficient.
baston.....	tié.....	club; cane.
baul.....		trunk.
beber.....	japú.....	to drink.
bestia.....	ka-gu.....	horse; beast.
bien.....	utz-at-ku.....	good; well.
blanco.....	su-suk.....	white.
boca.....	lak-ti.....	mouth.
bonito.....		good.
borracho.....	huik-et.....	drunkard.
bota.....		shoe.
bote.....	hu-kub.....	boat.
botilla.....		wine-bag.
brazo.....	lah-k'ub.....	arm.
brincar.....	la guélitz.....	to jump.
buey.....	huakasch.....	ox.
bulto.....		package; burden.
burro.....		donkey.
buscar.....	suk-lán.....	to seek.
cabal.....	tzuk-úl.....	exact; right.
caballo.....	ka-gu.....	horse.
cabello.....	zu-zil.....	hair.
cabeza.....	jol.....	head.
cadena.....		chain.
caer.....	híaj-lel.....	to fall.
caja.....		box.
cal.....	tián.....	lime.
calentura.....	k-ak.....	fever.
caliente.....	tik-hual.....	hot.
calor.....	k'ama-tik-hual.....	heat.
cama.....	tzsch-ak.....	bed.
cambiar.....	laj kesch.....	to change.
camino.....	bí.....	road.
chamarra.....	zut.....	blanket.
camisa.....	buj-k.....	shirt.
campana.....		bell.
cansado.....	luj-wen.....	tired.
caña.....	sik-ut.....	cane; reed.
cara.....		face.
carcel.....		prison.
carga.....	kutsch-ul.....	load; burden.
carne.....	gue-el.....	meat; flesh.
caro.....	kabuli tiojol.....	dear; expensive.
carta.....	jun.....	letter.
casa.....	odiot.....	house.
casar.....	niuk-punel.....	to marry.

castigar	mujatz	to punish.
cavar	tio-kó	to dig.
cazar		to hunt.
ceniza	ti án	ashes.
cerca	luk-ulisch	near.
cerrar	mup-ú	to close.
cicatriz		scar.
cielo	panchan	sky.
cierto		sure; certainly.
cinta		cinch.
citar	mua suben	to cite.
claro	jamul	clear.
clavar	tzuk-pu	to nail.
cobrar		to pay.
coger		to gather.
cola	tschuk-ú	tail.
colgar		to hang up.
colocar	hojk-an	to arrange; to place-
colorado		red.
comer	chuchui	to eat.
como	hué-el	how?
compañero		companion.
componer	muj-mel	to compose; to make.
comprar	muj munie	to buy.
comprender		to understand.
con	hitiok jonón	with.
concluir	schuj-ti	to conclude.
condenar		to condemn.
condicion		condition.
conducir		to conduct.
conejo	tí-ul	rabbit.
confianza		confidence.
conforme		agreed.
confundir		to confound.
conmigo		with me.
conocer	mubmic	to be acquainted with.
conseguir	muj-zucklán	to succeed.
consejo		counsel.
consolar		to console.
constar	me-lél	to be certain; consist of.
contar		to count.
contener		to contain.
(estoy) contento	uzat-añón	content.
consistir		to consist.
continuar		to continue.
contra		against.
copa		cup.

coraje.....	mich-ón.....	anger; vexation.
corazon.....	pusik-al.....	heart.
corcho.....	poit'é.....	cork.
cordel, cordon	pui.....	cord.
correo.....		mail; post.
correr.....	animál.....	to run.
cortar.....	zepé.....	to cut.
corte.....	kom.....	edge; cut.
cosa.....		thing.
cosecha.....		crop; harvest.
coser.....	tzi-soñel.....	to sew.
costal.....	coschtial.....	sack; bag.
crecer.....		to grow.
creer.....		to believe.
criatura.....	allul.....	infant.
crimen.....		crime.
crin.....		mane.
crudo.....	tzej-tión.....	raw.
cruel.....		cruel.
cruz.....		cross.
cuadro.....		frame; square.
cual.....	wakián.....	which?
cuando.....	vaki hora ma tilel.....	when do you go?
cuanto.....	jaipel.....	how much?
cuarto.....	mal.....	room.
cubierta.....		cover.
cubrir.....		to cover.
cuchillo.....	cuchillu.....	knife.
cuchara.....		spoon.
cuello.....		neck.
cuenta.....		account.
cuerda.....	kaschlan-tschujan.....	cord.
cuerno.....	schu-lub.....	horn.
cuero.....	ni-uk-ul.....	hide; skin.
cuidar.....	kunun-tiän.....	to take care.
culebra.....	lu-kum.....	snake.
culpa.....	amúl hatiet.....	thy fault.
cuñado.....	ja-an.....	cradle.
cura.....	tia-lá.....	care.
curar.....	mazuk-án.....	to care for; to cure.
dar (me lo)...	ak eniün.....	give it (to me).
deber.....	bet.....	to owe.
debil.....		weak.
digalo.....	subén.....	tell it (to me).
decidir.....	jul-él.....	to decide.
dedo.....		finger—or toe.
dejar.....	kuyú.....	to leave.

delito	mul	fault; crime.
delante		before.
delgado	jay	thin; delicate.
demas (los)	jambo	the rest.
dentro		within.
denunciar	muj suben	to denounce.
derecho	tioj	right; law.
desarrollarse . . .		to develop itself.
descansar	muk-kusché usikul . .	to rest.
descomponer . . .		to disarrange.
descuidar		to be careless.
desde (hoy)	gulé	hereafter.
deseo		desire.
desgracia	k'untic	misfortune.
despacio		quick.
despachar		to dispatch.
despertar	tschoj hul	to awake; to revive.
despues		well then.
destruir		to destroy.
detener	pik-tián	to detain.
deuda	bet	debt.
dia	k'in	day.
diente	lak é	tooth.
diferencia		difference.
difícil	matsch-mejlik	difficult.
dinero	tiak-üi	money.
direccion		direction.
distante	niat	distant.
doblar	lalak puk	to double.
doler	k'usch	to feel pain.
dolor		pain.
domingo		Sunday.
donde	waki	where.
dormir	guyel	to sleep.
dudar	mach-kojil	to doubt.
dueño	i-um	owner.
dulce	tzsch i	sweet.
durante		while.
duro	tiucán	hard.
echar	ak-én	to throw.
edad		age.
educar		to lead out.
elegir		to select.
embudo	burrik	funnel.
empedrar		to pave.
empezar	muakajel	to commence.
enaguas	majz	skirts.

enamorarse...		to be in love.
encargo.....		charge.
encima de.....	si-pam.....	from above.
encontrar.....	muj tia.....	to encounter.
enemigo.....		enemy.
enfermedad.....	k'am.....	to be ill.
enfermo.....		ill.
engañar.....	alot.....	to mislead.
enlodar.....		to daub.
enredar.....		to entangle.
enseñar.....	muj pusé.....	to show; to instruct.
ensender.....		to understand.
enteoro.....		entire.
enterrar.....		to bury; to inter.
entrada.....		entrance.
entrar.....	muj ochel.....	to enter.
entregar.....	muak-uk-en.....	to deliver.
enviar.....		to send.
envidia.....		envy.
equipaje.....	maleti'c.....	equipment.
esconder.....		to hide.
escopeta.....	julonib.....	shot-gun.
escribir.....		to unite.
escuela.....		school.
ese, esa, eso...	him.....	this.
espantar.....	muj-bukmán.....	to frighten.
espejo.....		mirror.
esperar.....	pik-tian.....	to wait.
espeso.....		thick.
espina.....	tschisch.....	spine.
esposo.....	nioth-hual.....	spouse.
esquina.....		corner.
estoy.....	anku, guanet, gua-anón.	I am.
este, esta, esto.		this.
estomago.....		stomach.
estrella.....	EEK.....	star.
estupido.....		stupid.
facil.....		easy.
falso.....		false.
falta.....	añtio yom k'in.....	lack.
fallecer.....	tschu-mi.....	to die.
fango.....		mire.
fatigar.....	luj-bel.....	to weary.
feliz.....		happy.
feo.....		ugly.
fertil.....		fertile.
fiado.....	bet.....	trust.

fiel.....*		faithful.
fijo		fixed.
flojo.....		loose.
flor		flower.
fondo		bottom.
forzar	puerza.....	to force.
frio	zunial	cold.
frito		fried.
fruta		fruit.
fuego.....	k'ak.....	fire.
fuerte	p'utial.....	strong.
fumar		to smoke (tobacco).
gallina.....	mut	hen.
gana (tengo) ..	com-kú	longing (I have).
ganar.....		to gain.
garganta.....	b'ita.....	throat.
gastar	mijilel.....	to spend.
gato.....	mís	cat.
gobierno.....	koñarol.....	government.
golpe.....		blow; stroke.
gordo.....	jupén.....	fat.
gota.....		drop.
grande.....	niuk.....	large, grand.
grano		grain.
grave.....		heavy; grave.
gritar.....	oñel.....	to cry out.
grueso		thick; fat.
gusano	chunil.....	worm.
gustar		to enjoy.
haber.....		to have.
habitar		to live; to dwell.
hablar	s' ian.....	to speak.
hacer	tschalén.....	to make.
hacha		hatchet.
hambre.....	huiñial.....	hunger.
hasta (mañ) ..	ikul tió	until (tomorrow); goodbye.
hay	ankú	there are.
helar.....		to freeze.
herida		wound.
hermano	guskún	brother.
hermoso		beautiful.
hervir.....	lok	to boil.
hielo		ice.
hierva.....	pi-mel.....	herb (?).
higado.....		liver.
hija	kalobil.....	daughter.
hindrar.....	sik-tiém.....	to hinder.

hoja.....	yopón.....	leaf.
hombre.....	huinik.....	man.
hondo.....	awan.....	deep.
hora.....		hour.
hormiga.....	schí-nitsch.....	ant.
hoy.....	gule (sach-mals).....	today.
huerfano.....	maniktial.....	orphan.
hueso.....	b' ukel.....	bone.
huevo.....	tiu-mut.....	egg.
huir.....	puz'el.....	to flee.
hule.....		rubber.
humear.....		to smoke.
humedo.....	atsch.....	humid.
humo.....	tscha-yil.....	smoke.
hamaca.....	aa-b.....	hammock.
iglesia.....	clesia.....	church.
igual.....	lajal.....	equal.
imitar.....		to imitate.
incendio.....	pulel.....	fire; conflagration.
indicar.....	subén.....	to indicate.
infierno.....		hell.
informar.....		to inform.
ingrato.....		ungrateful; ingrate.
injusticia.....		injustice.
insultar.....	yi leñon.....	to insult.
interior.....		interior.
inundacion.....	but kujel.....	inundation.
inutil.....	mach wenisch.....	useless.
ir (me voy).....	mach-lel.....	to go.
jabon.....	schapon.....	soap.
jamás.....		never.
jarra.....		jar.
jornalero.....		day laborer.
joven.....	tschit-tiun.....	youth.
juez.....		judge.
juntar.....		to join; to gather.
justo.....		just.
labio.....		lip.
labor.....		labor.
lado un.....	hung-guel.....	one side.
ladron.....	schuj-tich.....	thief.
lana.....		wool.
largo.....	tiám.....	long.
lastimar.....	zep.....	to regret.
lavar.....	guj-onúl.....	to wash.
leche.....	lech.....	milk.
leer.....	lak tik eni jun.....	to read.

legua		league.
lejos	niat	far; distant.
levantar	tschoj-hiel	to rise.
libra		pound.
ligero	tzeniun	light; slight.
limón	elemusch	lemon.
limpiar	ak-in	to cleanse.
linea		line.
loco		fool.
lodo	ok-ol	mud.
lomo		ridge.
lugar		place.
lumbre	k'ak	fire
luna	ú	noon.
luz	k'ak	light.
llamar	puyu	to call.
llegar	k'oti	to arrive.
llenar	butin	to fill.
llevar	tschum machlel	to carry.
llorar	uk-el	to weep.
llover	tya-lisch ja-al	to shower.
lima	sii	lima.
macho	tschi-tion'	male.
madera	tic'	wood.
madre	niá	mother.
madrugar	tschoj-iel iktió	to dawn.
madurar	k'unisch	to ripen.
mais	ischim	maize.
malo	jon-tiol	bad.
maltratar		to treat badly.
manchar		to spot.
mandar	me-maj-lel	to command; to send.
mano	k'ub	hand.
manteca	léu	lard.
manzana		apple.
mañana	ischk-ul	tomorrow.
marido	niosch-yal	husband.
martillo		hammer.
mas	jambo	more.
matar	zunzán	to kill.
mayor		greater.
mecha		wick; fuse.
menor		less.
mentir	lotch	to lie; to speak falsely.
mes	ú	month.
meter		to measure.
mezclar		to mingle.

miedo	b'uk-nián	fear.
miel	tschab	honey; syrup.
mientras		meantime.
mirar	k'ele	to look at.
mismo	hinitsch	same.
mitad	olil	half.
mojar	a'tsch	to dampen; to wet.
mono		monkey; doll.
morder	zik-uschon	to bite.
morir	tschu-mel	to die.
monstrar	pu-zu	to point out.
mover	nik-an	to move.
mucho	kabulisch	much.
mudar		to silence.
mujer	kij mam	woman.
mula		mule.
multa		fine; penalty.
musgo		moss.
muy		very.
mundo	panumit	earth; world.
muchacha	allusch-tschok	girl.
muchacho	tschok-tuiun	boy.
nacer	tiok í-alul	to be born.
nada	manik	nothing.
nadie		no one.
naranja	alashasch	orange.
nariz	lak-ni	nose.
navaja	navaschasch	knife.
necesario		necessary.
negro	i-ik	black.
niebla		mist.
nieve		snow.
no	manik	no.
noche	ik-isch	night.
nombre	tschuks ak'ava	name.
nosotros	jonió la	we; us.
nube		cloud.
nudo		knot.
nuevo	zijitio	new.
nunca		never.
nutrir		to nourish.
obedecer		to obey.
obligar		to oblige.
oscuro	ik-isch	dark.
obsequiar	maj-tián	gift.
ocultar	mach-asub	to hide; to conceal.
ocupar		to occupy.

ofender		to offend.
ofrecer		to offer.
oir	zakubi	to hear.
ojo	g'uty	eye.
oler		to smell.
olvidar	mach-k'ajalisch	to forget.
olla	p'et	water-jar.
orar	resal	to pray.
oreja	lak tschik'in	ear.
oro		gold.
otoño		autumn.
otro	jambo	other.
oveja		sheep.
paciencia		patience.
padre	tiat	father.
padrino	jala-tiat	god-father.
pagar	tiojó	to pay.
país	lumal	country.
paja	jam	straw.
pajaro	mut	bird.
palabra		word.
palanca	a-u-té	lever.
palido	k'uniet	pale; pallid.
palo	tic'	stick.
paloma	zu-mut	dove.
pan	kaschlan-huaj	bread.
pantalon	guesch	pantaloon.
pañó	katschilul	cloth.
papel	jun	paper; part.
par		pair; equal.
para		for.
parar	gua-til	to rise.
pariente	pi-úl	relative.
parir		to bear; produce.
parte		part.
pasado	mañ-chabi	past.
pasear	paschial-	to walk.
paso		pass.
patio	pam-otiot	court-yard.
pato	petsch	duck.
pavo	aj-zo	peacock.
pecho		breast.
pedazo		fragment.
pedir	k'atin	to ask; to beg.
pegar	j'az-ú	to paste; to strike.
peine	schí-yib	difficulty.
pelear	letiu'	to fight.

pelo.....	zuzél.....	hair.
pena.....		pain.
peor.....		worse.
pequeño.....	big-it.....	little.
percal.....		percale.
perder.....	saj-ti.....	to lose.
perdonar.....		to pardon.
perito.....		puppy.
permiso.....		permission.
perro.....	z'i'.....	dog.
pero.....		but.
perseguir.....	eñeñ tschukú.....	to follow; to pursue.
pertenecer.....		to pertain to.
pesado.....	alutsch.....	heavy.
pesar.....		to weigh.
pescado.....	tschug.....	fish.
peso.....		peso; dollar.
picar.....	tzik-uschón.....	to prick; to sting.
pico.....		peak.
pié.....	k'ok.....	foot.
piedra.....	tiu'n.....	stone.
piel.....	putschi.....	skin.
pierna.....	y'a.....	leg.
pieza.....		room; piece.
pimiento.....		pepper.
pino.....	tiaj.....	pine.
planta.....		plant.
platano.....	ja-as.....	banana.
plato.....	latui'.....	plate; flat.
pleito.....	letiu.....	contest; fight.
plomo.....		lead; plummet.
pluma.....	k'uk'un.....	feather.
pobre.....		poor.
poco.....	tzi'-tia.....	little.
poder.....	mej-lel.....	power.
polvo.....	tsu-lum.....	dust.
polvora.....	zi-bik.....	powder.
poner.....		to place.
por.....		for; by.
porque.....	tschuk-i'.....	why?
posada.....		lodging.
posible.....		possible.
precio.....	tiojel.....	price.
preferir.....		to prefer.
pregunta.....	k'aj tin.....	question.
preparar.....		to prepare.
presente.....		present.

prestar.....	maján	to loan.
primavera....		spring.
principiar....	kajel	to begin.
probable.....		probable.
probar.....		to prove.
profundo.....	tiám.....	profound; depth.
prometer.....		to promise.
pronto.....		promptly; soon.
propiedad....	tscha-au	property.
propio.....		own; personal.
proteccion....		protection.
provecho....		advantage.
proximo.....		next.
prueba.....		proof.
pudrir.....	ok-wen	to rot.
pueblo.....	lum.....	town.
punte.....	pan-tic.....	bridge.
puerco.....	tschi t'ám.....	hog.
puerta.....	ti-odiot.....	door.
pulga.....	tschak.....	inch.
pulmon.....		lung.
punta.....	ni.....	point.
puño.....		dagger.
purgante.....		purgative.
que (dice)....	tschuki-masub.....	what (do you say?)
que.....		what; that.
quebrar.....	tiob-o	to break.
quedar.....	jilel.....	to last; to remain.
quejarse.....	suben.....	to complain.
quemar.....	pulém.....	to burn.
querer.....		to love.
queso.....		cheese.
quien(lo hizo).	maki ti tschalen.....	who (did it)?
rabia.....		rage.
rabioso.....		rabid.
raíz.....	gui-tic.....	root.
rajado.....	tiob-ó	split.
rama.....	k'ub-tic'	branch.
raro.....		rare.
raton.....	zúk	rat.
raya.....		ray.
rebajar.....	jusán	to lower.
recado.....		message.
recibir.....	tschu-mú	to receive.
recoger.....		to gather.
recordar.....	niatián.....	to record.
recto.....	tioj.....	right.

red	tschim	net.
redondo		round.
refresco		refreshing.
regalar	maj-tián	to regale; to present.
regañar	wichalen aleya	to blame; to scold.
regar		to water.
reir	zenia	to laugh.
relampago		lightning.
remedio	z'ak	remedy.
remoto		remote.
remover		to remove.
renovar		to renew.
repartir		to divide; to distribute.
repente		suddenly.
repetir		to repeat.
resistir		to resist.
respirar		to respire.
reves (al)	boti'ol	backward.
revolver		to revolve.
rico		rich.
riesgo		risk; danger.
rincón		corner.
rio	na	river.
robar	tschujtoch	to rob.
rodilla	pisch	knee.
rogar		to beseech.
romper	tzi-li	to break.
ropa		clothing.
roto	jup-én	broken.
rubio		ruddy.
rudo		rude.
rueda		wheel.
ruido	puz-el	noise.
saber	ku-jil	to know.
sabroso	su-muk	savory.
sacar	lok-esan	to take out.
sal	az-am	salt.
salida	lok-el	saline
salir		to sally.
saltar		to leap.
salud		health.
saludar		to salute.
salvaje		savage.
sana	k'ogan	to render healthful.
sangre	tschi-tsch	blood.
sano		sane; sound.
santo	tschul tiat	saint.

sartén	schaltien	frying-pan.
secar	tik-hinisch	to dry.
sed	likin-tiil	thirst.
se da	schella	silk.
seguir		to follow.
segun		according as
seguro		secure.
semana		week.
sembrar	púk	to sow.
semilla	pa-k	seed.
sencillo		simple.
sentarse	buchlén	to seat oneself.
sentir		to feel.
separar		to separate.
sepulcro		sepulchre.
serio		serious.
servicio		service.
siempre		always. [forest.
sierra		mountain; mountain
signo		sign.
silla		chair; saddle.
sin		without.
sirviente		servant.
sobrar		to remain over.
sobre		over.
sol	k'ak-al	sun.
solamente		only.
solo		alone.
sombra		shade.
sombrero	pisch-ol	hat.
sordo	u-ma	deaf.
suave		gentle; suave.
subir	lez-el	to mount.
sucio		dirty.
sudar	bulitsch	to perspire.
suegro	ni-al	father-in-law.
sueño	guyél	sleep.
susto		fright.
suyo		his; your.
tabaco	ujtz	tobacco.
tabla	job-é	board.
tambien		also.
tanto		so much.
tapa	suk-il	cover.
tarde	ik-isch	late; afternoon.
techo		roof; thatch.
temer	buk-nián	to fear.

tempestad....		tempest.
temprano	zuk-á.....	early.
tenaza.....		claws.
tender.....		to.
tener.....	anku.....	to have.
tenedor.....		fork.
terminar.....	ji-lél.....	to terminate.
testigo.....		witness.
tiempo.....		time.
tienda.....		store.
tierra.....	lum.....	land.
tijera.....	tie-chelesch.....	shears.
tirar.....		to throw; to aim.
tocar.....		to touch.
todo.....	pek-túl.....	all.
tomar.....	jap, lemé.....	to take; to drink.
tonto.....		foolish.
toro.....	makasch.....	bull.
tortilla.....	guaj.....	tortilla; corn cake.
tortuga.....		turtle.
testar.....	goch-an'.....	to toast.
trabajar.....	troniel.....	to work.
traer.....	tsch'untilel.....	to carry.
trago.....	lembál.....	drink.
trampa.....	pejz.....	trap.
trapo.....		cloth.
tras.....		behind.
trato.....		conduct; business.
tripa.....	bik-il.....	intestine.
triste.....		sad.
tronar.....	tioj-mel.....	to thunder.
tronco.....	schuk-tié.....	trunk.
trote.....		trot.
tuerto.....	tz-o-gutz.....	squint-eyed.
tumor.....	sich-tiém.....	tumor.
ultimo.....		last.
unir.....		to unite.
uña.....		one.
urgente.....		urgent.
usar.....		to use.
útil.....		useful.
vaca.....		cow.
vacío.....	jocholi:ch.....	empty.
vaina.....		scabbard.
valer.....	tio-jol.....	to be worth.
valle.....		valley.
vapor.....		vapor; steamboat.

vaso.....		glass.
vecino.....	pi-úl.....	neighbor.
vela.....	nichim.....	candle.
vena.....		vein.
vender.....	tscho-nié.....	to sell.
veneno.....		poison.
vengar.....		to avenge.
venir.....	tilel.....	to come.
ventaja.....		advantage.
ventana.....		window.
ver.....	kilán.....	to see.
verano.....	k'in tiuñul.....	summer.
verdad.....	melel.....	truth; true.
verde.....	hie-jiusch.....	green.
verdura.....	allul.....	greenness; verdure.
vereda.....		path; trail.
vergüenza....	kijin.....	shame.
vez.....		time; once.
viaje.....		voyage; journey.
vida.....		town—local capital.
viejo.....	schniosch, schniheb..	old.
viento.....	ik.....	wind.
visitar.....	ju-lá.....	to visit.
vivir.....		to live.
volar.....	guij-lel.....	to fly.
volver.....	su-j-tié.....	to turn; to return.
vomit.....	schenel.....	to vomit.
voz.....	hatiet.....	voice.
vuelta.....		return.
y.....		and.
ya (viene)....	tialisch.....	there (he comes).
yerba.....	yopóm.....	herbage; grass.
zanja.....	tscha-kum.....	ditch.
zapato.....	schumieb.....	shoe.
zorro.....	pajui.....	fox.
1.....	ump-el.....	one
2.....	tschapp-el.....	two.
3.....	uschep-el.....	three.
4.....	tschunp-el.....	four.
5.....	jop-el.....	five.
6.....	wacp-el.....	six.
7.....	wucp-el.....	seven.
8.....	waschae-el.....	eight.
9.....	walump-el.....	nine.
10.....	lump-el.....	ten.

ERRATA.

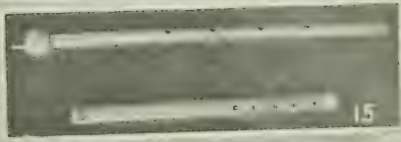
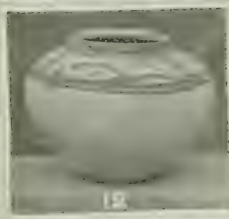
Page 76, eighth line under cut, for “*o.k.*” read “*oaka.*”

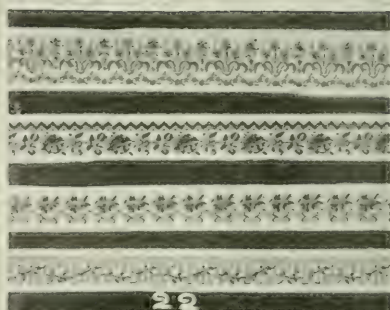
Page 124, eighth line, for “*ærocephaly*” read “*acrocephaly.*”

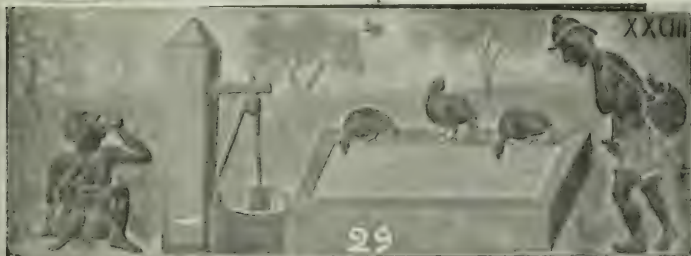
Page 137, ninth line from bottom, for “*per su casa*” read “*por su casa.*”









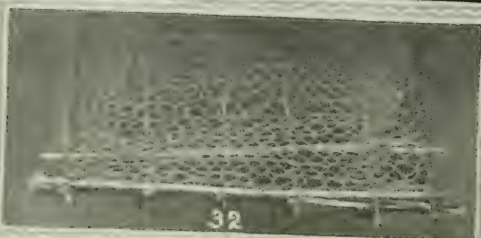




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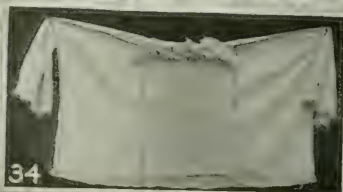
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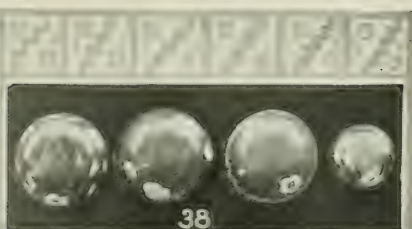
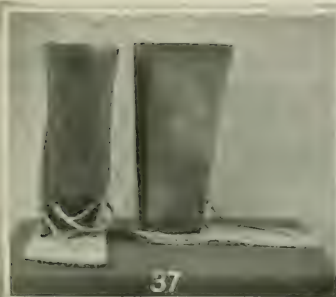
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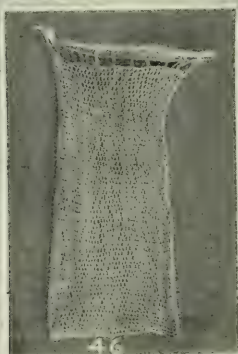
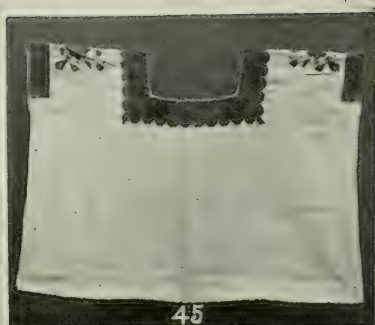
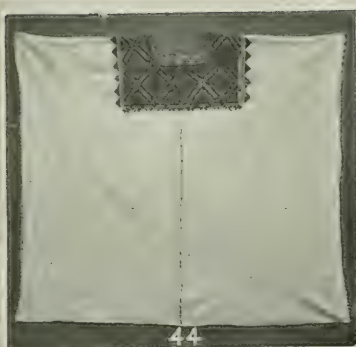


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HELICINA OCCULTA Say.

BY B. SHIMEK.

The geographical and geological distribution of *Helicina occulta* Say presents some points of unusual interest.

This mollusc was first described by Thomas Say,¹ who recorded its discovery as follows: "All . . . are dead and bleached. They occur abundantly in the ragged and abrupt 'bluff' half a mile below New Harmony, near the river bank, with many *Helices* that are commonly found in the western states." The "bluff" is loess, and in the loess of the northern Mississippi valley, especially in the belt extending from Indiana to Nebraska, this species is one of the most characteristic fossils. This latter fact demonstrates that it was once generally distributed throughout the Central Region, and that its widely separated modern colonies are mere remnants of a once abundant fauna.

The species was first recognized as a modern snail in 1832, when Jacob Green described it from Pennsylvania as *Helicina rubella*.² Doubt was formerly expressed concerning the identity of *H. occulta* and *H. rubella*. As early as 1846 Dr. Amos Binney recognized the identity of the fossil and modern forms,³ and again in 1851, referring to *H. occulta*, he stated that he could not doubt its identity with *H. rubella*.⁴ But in Vol. II., p. 357 (l. c.) he expressed the opinion that it is extinct, and hence distinct from *H. rubella*. He figured both on pl. LXXIV., figs. 1 and 2, Vol. III. In 1859 Dr. W. G. Binney, in Vol. IV., of the same work, p. 193, was "inclined to consider *Helicina rubella* as a synonym," but in 1865⁵ he described it as a fossil, but included *H. rubella*, the modern form, as a synonym!

1 Transyl. Jour. of Med., Vol. IV., p. 529, 1831; reprint in Say's Am. Conch., No. 5. Pl. 46, figs. 4, 5, 6, 1832, and in Binney's edition, pp. 37-8, 1856.

2 Doughty's Cabinet of Nat. Hist., Vol. II., p. 291.

3 Proc. Boston Soc. of Nat. Hist., Vol. II., p. 130.

4 Terr. Air-br. Moll. U. S., Vol. I., p. 184.

5 Smith. Mis. Coll., 144, "Land and Fresh-water Shells of N. Am.," pt. iii.

Geo. W. Tryon also considered the fossil and modern forms identical,¹ and the identity has not since been questioned by anyone familiar with both forms.

The first additional report of the occurrence of recent shells of this species following Green's original discovery, was made in 1859 by W. G. Binney,² who received an apparently recent specimen, collected by I. A. Lapham at Sheboygan, Wis. Concerning this specimen he subsequently noted:³ "Fossil, color remaining." The shell is, however, evidently recent.

The next additional discovery was made by Prof. McDonald at Lexington, Va., and was reported by Tryon in 1868.⁴

E. R. Leland next reported it from Whitefish Bay, north of Milwaukee, Wis., in 1870.⁵

The first published report of recent specimens from Iowa was made by R. E. Call in 1882,⁶ who, after declaring that the species is probably extinct, added in a footnote that the species was taken in the vicinity of Iowa City. The specimens on which this statement was based were sent to Call by the writer, who, with Dr. H. A. Pilsbry, discovered the species in 1880⁷ at a point six miles north of Iowa City. Dr. C. R. Keyes subsequently reported on the locality,⁸ but, judging from his description, he had not seen it. This, however, was not the "first discovery" of living specimens in the state, as reported by Keyes. Prof. F. M. Witter received specimens from Dr. E. H. King Feb. 10th, 1878.⁹ They were collected at Eldora, Hardin county, probably in 1877. The species was re-discovered in the same locality in 1881 by Mr. J. W. Preston.*

In 1887 R. E. Call reported living specimens from South Pittsburg, Tenn.,† and the following year Prof. J. M. Holzinger

1 Am. Jour. Conch., Vol. IV., p. 12, 1868; Monograph of the Terr. Moll. of the U. S., p. 152, 1868.

2 Terr. Air-br. Moll. U. S., Vol. IV., p. 193.

3 Smith. Miscell. Coll., 1. c., p. 112.

4 Am. Jour. Conch., Vol. IV., p. 12; Monograph Terr. Moll. U. S., p. 152. He repeated this report in Am. Jour. Conch., Vol. V., p. 118, 1870.

5 Am. Jour. Conch., Vol. V., p. 118, footnote.

6 Am. Nat., Vol. XVI., p. 351.

7 See Dr. H. A. Pilsbry's report, Nautilus, Vol. III., p. 20, 1890.

8 Bull. Essex Inst., Vol. XX., p. 15, 1889; Nautilus, Vol. III., p. 19, 1889.

9 He did not report on them, however, until 1883. See his Mollusca of Muscatine County, p. 24.

* See writer's report in Bull. Lab. Nat. Hist. State Univ. of Iowa, Vol. I., p. 61, 1888.

† Bull. Washburn College, Vol. II., p. 16.

reported it from Stockton and Winona, Minn.,¹ where he first collected it in 1886.

In 1890 G. T. Marston found it at De Pere, Wis.,² and in 1893 it was discovered in western Pennsylvania, in Alleghany county, by S. H. Stupakoff.³

In 1894 Prof. A. G. Wetherby reported it living on Roan Mt., N. Car., and in 1897 Pilsbry added Athens, Ill., Harriman, Tenn., and Natural Bridge, Va., to the list of localities.⁴

In 1899 Prof. T. E. Savage brought a specimen from Decorah, Iowa, in a collection of moss, and in 1900 J. H. Ferris discovered it in Blount county, Tenn., the southernmost limit of its known distribution.⁵

In 1901 the writer found numerous living specimens in the northwest corner of Dubuque county and the adjoining portion of Clayton county, Iowa,⁶ and in 1903 along the Upper Iowa, and some of its tributaries, in the northeast corner of Howard county, and at Kendallville, Plymouth Rock, Decorah, Ft. Atkinson, etc., in Winneshiek county, Iowa.

Finally, the collection of the Smithsonian Institution contains a specimen (No. 150175) from Lee county, Iowa, collected by Van Hynning, but without date or other information. So far as the writer knows this completes the list of original references to recent specimens.

The first known fossil specimens were Say's types from New Harmony, Ind., already noticed. The first Iowa fossil specimens were reported from Council Bluffs by D. D. Owen⁷ under the name *H. oculina*.

It has since been included in the great majority of lists of loess fossils from the region lying north of Kansas and Tennessee.

This species has usually appeared under the generic name *Helicina*, but in a few instances it was published under the sub-generic name *Oligyra*.⁸

1 16th An. Rep. Minn. Geol. Sur., p. 491.

2 Nautilus, Vol. III., p. 113, 1890.

3 Nautilus, Vol. VI., p. 24. See also Vol. VII., p. 135.

4 Nautilus, Vol. XI., p. 46. Also Pilsbry and Johnson's Catalogue of the Land Shells of N. America, p. 2, 1898.

5 Nautilus, Vol. XIV., p. 53.

6 Bull. Lab. Nat. Hist., State Univ. of Ia., Vol. V., p. 200; Am. Geol., vol. XXVIII., p. 348.

7 Report of a Geol. Sur. of Wis., Ia., and Minn., p. 132, 1852.

8 Call, R. E., Bull. Washburn Coll., Vol. II., p. 16, 1887. Am. Jour. Sci., Vol. XXIV., pp. 216, 221, 1882.

The specific name has appeared as *oculina*¹ and *occulata*,² but these may have been typographical errors, though the latter is repeated.

The species has also been confused with *H. orbiculata*, a southern form. Dr. Amos Binney reported³ the fossil form from Mississippi, which is evidently an error, as *H. orbiculata* is the southern species, both recent and fossil. Aughey's unreliable lists⁴ on the other hand contain *H. orbiculata* from Nebraska, which is manifestly an error, *H. occulta* being the species found in the loess of Nebraska.

In view of the abundance and wide distribution of the species as a fossil in the loess of the northern Mississippi valley, the habits of the living forms are of special interest because of the light which, in common with other species of shells found in the deposit, they throw upon the conditions under which the loess was laid down.

The writer has collected living specimens of this species in Johnson, Hardin, Dubuque, Clayton, Winneshiek and Howard counties in Iowa, and has seen one of the localities near Winona, Minn., where Prof. Holzinger collected his specimens. Invariably the specimens were found in rough, well-wooded territory, in loose leaf-mould, and under and among the fallen leaves, etc., which usually carpet the surface between the smaller plants which are characteristic of such shaded hillsides. In some of these localities the surface was also strewn with scattered fragments of limestone. The shells were invariably found on high grounds which were not subject to overflow.

Green reported his *H. rubella* simply from "hills in Western Pennsylvania." Leland's Whitefish Bay specimens (l. c.) were collected "upon the bluff at the lake, which, at that point, is somewhat wet and boggy, and covered with a growth of Tamarack, Arbor-Vitæ, and Juniper. They were found under dead leaves...." Wetherby's Roan Mt. specimens were found "on damp rocks and about them, under a slight covering of leaves." Notwithstanding the fact that the strictly terrestrial habits of

¹ Owen, D. D., l. c., pp. 132, 135, 1852.

² Call, R. B., Am. Nat., Vol. XV., pp. 586, 784.

³ Vol. II, l. c., p. 100.

⁴ Aughey, S., U. S. Geol. Sur. of Col. and Adjacent Terr., Hayden, p. 268, 1876; Sketches of the Physical Geog. and Geol. of Neb., p. 290, 1880.

this species have been known for so many years, it has been reported as more or less aquatic, probably because of its relationship with certain aquatic forms. Thus Todd speaks of "some semi-aquatic species," as *Succineae* and *Helicinas*.¹ Witter cautiously says it "is classed as a water breather,"² and Call once included it with fresh water shells!³

This species has also been cited to prove the depauperation of loess shells. Call says:⁴ "In all the recent specimens examined, upwards of one hundred and fifty, the smallest of the living forms were larger than the largest of the fossil ones."

In the same paper, p. 216, he reports the diameter of the fossil shells as 6.5^{mm}, and that of recent shells as 9^{mm}. The recent specimens which Call examined were from the Iowa City colony. Concerning these shells the writer, in 1888, said:⁵ "The fossils average smaller than the several thousand recent specimens taken near Iowa City, but are nearly equal to the specimens from Eldora, Iowa." In 1890, after securing more material, he reported⁶ that "on the whole the fossils are a little smaller in average size than the recent shells, though many of them exceed the smaller ones from Hardin county. None of the fossils equal the largest Johnson county specimens." Additional material necessitates the partial revision of even the latter statement.

The writer has examined many times the number of recent shells mentioned by Call, and among them not one measures as much as 9^{mm} in diameter. A very few exceptionally large shells in the Iowa City lot measure 7.5^{mm} in diameter,⁷ but the average in this set is about 6.25^{mm}. The Eldora, Hardin county, specimens range from 5.5^{mm} to 6.5^{mm}, the average being 6^{mm}; those from Howard county average 6.5^{mm}; and those from the several Winneshiek county localities range from 6 to 7^{mm}. Those from Clayton county measure from 6 to 6.75^{mm}, the average being 6.5^{mm}, while those from Dubuque county, near by, range from 5 to 6.5^{mm} and average about 6^{mm}. The recent shells thus vary

1 Proc. A. A. A. S., Vol. XXVII., reprint, published in 1879, p. 6.

2 Paper before Muscatine Acad. Sci., Feb. 10, 1879.

3 Am. Nat., Vol. XV., p. 586, 1881.

4 Am. Jour. Sci., 3rd Ser., Vol. XXIV., p. 221.

5 Am. Geol., Vol. I., p. 152.

6 Bull. Lab. Nat. Hist., St. Univ. Ia., Vol. I., p. 201.

7 In all cases the greater diameter is here measured.

from 5 to 7.5^{mm.} in diameter, very few, however, exceeding 7^{mm.}. A single specimen from an alluvial deposit near Decorah, Iowa, probably rather recent, measures 7^{mm.}.

The fossil specimens, of which the writer has examined several thousand from nearly a hundred different localities in the northern Mississippi and Missouri valleys, range from 5 to 7.25^{mm.} in diameter, the average being about 6^{mm.}.

A comparison of the large recent and fossil series disproves Call's representation that the fossils are greatly depauperated. There is some variation in size, but this may be observed in both the recent and fossil series, and its range is not materially different in these series.

The recent recognition of several loesses,¹ and the fact that *H. occulta* occurs, so far as the writer knows, in all but the distinctly differentiated deposits of the post-Wisconsin,² makes a comparison of the fossil shells from the several loess-horizons desirable. The writer's series of fossils of this species from the post-Kansan and post-Iowan is especially large, and specimens from widely separated typical exposures were compared.

The shells from the pale bluish-gray post-Kansan loess yielded the following results: those from Muscatine, near Hershey Ave., measure from 5 to 6.5^{mm.}, the average being nearly 6^{mm.}; those from near Crescent Ave. in East Davenport measure from 5.5 to 6.25^{mm.} and average 6^{mm.}; those from Carroll, Iowa, vary from 6 to 6.5^{mm.}, the majority being 6^{mm.} in diameter.

Several large sets from the yellow post-Iowan loess measure as follows:

From Moline, Ill., from 5.5 to 7^{mm.},—average 6^{mm.}.

From several exposures at Iowa City, from 5.5 to 7.25^{mm.},—average a little more than 6^{mm.}.

From near Greenwood Park, Des Moines, Ia., from 5.5 to 6.5^{mm.},—average 6^{mm.}.³

From several exposures at Council Bluffs and Omaha, from 6 to 7^{mm.},—average a little more than 6^{mm.}.

¹ The post-Kansan, post-Illinoian, post-Iowan, and post-Wisconsin. See Bull. Lab. Nat. Hist., St. Univ. Ia., vol. V., p. 352, *et seq.*, 1904.

² *H. occulta* is not found in the post-Wisconsin loess, nor does it exist in Iowa within the Wisconsin drift area. The advance of the Wisconsin ice evidently has exterminated the species. If the post-Wisconsin can be differentiated outside of the Wisconsin drift-border, it will no doubt contain this species.

³ This is contrary to C. R. Keyes' statement (in the Nautilus, Vol. III., p. 18, 1889) that the fossils of this region are "strikingly depauperate."

From Lincoln, Neb. (probably post-Iowan), average 6^{mm}.

It will be observed that the range of size in the fossils is from 5 to 7.25^{mm}, and the average slightly exceeds 6^{mm}. In addition to the foregoing a large number of specimens from about seventy other localities was examined, with the same results. Some of these were from loess between Omaha, Neb., and St. Joseph, Mo., and from Eastern Missouri and Illinois, which was not satisfactorily differentiated.

As already stated, while there are variations in size in both recent and fossil shells, there is no marked depauperation of the fossils. In the material examined there is perhaps a slight preponderance of smaller forms in the post-Kansan loess, the average diameter being about 6^{mm}; those from the post-Iowan average a trifle over 6^{mm}, the largest approaching the largest recent forms; and the modern shells exceed this average by a small fraction. Every addition to the series, however, is likely to modify these averages. Moreover, the smallest fossils in the whole series are just equal to the smallest recent specimens from Iowa City and Dubuque county, and are barely exceeded by those from Eldora.

H. occulta is relatively most abundant in the post-Kansan loess, and while still very wide-spread in the Iowan, it becomes more local. As a modern shell it is extremely local, and the localities are far apart, the colonies appearing as remnants of a once common race, which is evidently running out. No one has yet given a satisfactory estimate of the time which has elapsed since the retreat of the Kansan ice. No one can determine the amount of time which was required to form the first post-Kansan soil (the gumbo), and render the surface conditions suitable for loess-deposition. Therefore, we cannot determine how long ago the earliest post-Kansan *Helicinas* lived. That the time was very great is certain, yet through it all these little molluscs have persisted with but little change. Each succeeding ice-sheet, the Illinoisan, Iowan and Wisconsin, wiped them out in the territory over which it passed, yet in many cases the species was again able to spread out from the territory which had not been reached by the ice to those drift-covered areas on which post-glacial loess-deposition was taking place. The species did not at any time extend far south, and these successive inroads finally almost

exterminated it. Other causes may have contributed to the same end, but it should be remembered that the species has remained practically unchanged since its earliest appearance, and that the modern colonies are remarkably uniform in habit, being strictly terrestrial and occurring in wooded areas. Both of these facts indicate a lack of plasticity and adaptability, which perhaps in part accounts for the partial extinction of the species, but they also seem to warrant the conclusion that it has changed but little in its habits.

It was formerly widely distributed over territory which is now largely prairie, and it is now uniformly found on well-wooded grounds. These facts suggest that our forest areas were once of much greater extent, and that in them a large part of the post-Kansan and post-Iowan loess was deposited. There are large areas in western Iowa and eastern Nebraska in which the upper part of the loess is coarser, and appears as if it might have been formed in more open country,¹ but this loess never contains the species here under discussion. It is usually without fossils, but when they do occur they are usually widely scattered shells of *Succinea grosvenerii*, an upland prairie species. It does not, therefore, follow that all the loess was deposited in woods, but the habits of *H. occulta*, and other species of like habits, which are associated with it in many loess deposits, indicate that such deposits were formed under forest conditions. Since many of these deposits are found in what is now open prairie, it follows that groves such as dot the eastern part of Iowa were formerly more generally distributed over the loess-bearing area. The destruction of these forests by each succeeding ice-sheet, and the interval which elapsed before other forests, or at least other vegetation could be developed, marked the inter-loessial period which separated two loess-periods even where one loess rests directly on the other.

¹ See Proc. Ia. Acad. Sci., Vol. VI., pp. 107-8. Jour. of Geol., Vol. VII., pp. 132-3.

MORE NOTCHED BONE RATTLES.

BY FREDERICK STARR.

On July 11, 1898, the Academy printed, in its Proceedings, my paper entitled "Notched Bones from Mexico." In that paper I described certain notched bones, now in my private collection, which were found in the State of Mexico. I mentioned Mr. Lumholtz's description of similar notched bones, found in the State of Michoacan, and questioned his interpretation of their use and significance. For me, these Mexican notched bones were used for grating the time for dancers, they were the musical instrument to which the Mexicans anciently applied the name of *omichicahuaz*. I compared the Aztec use of notched bones for such a purpose with the use of notched sticks among the Pueblo Indians of New Mexico and Arizona and the Tonkaways of Oklahoma. About a month after my article was in print, there appeared an elaborate paper on the same subject in *Globus* (*Altmexikanische Knochenrasseln*, *Globus*, Aug., 1898), by Dr. Eduard Siler of Berlin, who took the same position in the matter that I assumed.

Lately, I have chanced upon the use of similar notched rattles in two quite unexpected places and to-night am able to here show the specimens themselves. In overhauling the Academy's collections in archæology, I find two notched bones which were found years ago by Capt. Hall in a mound six feet high at Eagle Corners, Wisconsin. They are large rib bones, probably those of the moose (they are so labeled) and both are notched transversely by cuts, which are fairly evenly spaced and as deep as the nature of the bones will allow; the bones themselves are about fifteen inches long, slightly curved, and flattish; one of them bears thirty-four cuts, the other thirty-three. Formerly I should have looked upon these as tally-sticks marking some hunter's or warrior's count, and the thinness of the bones and consequent shallowness of the

cuts at first seemed to me against the use of these bones as notched rattles. The most casual examination, however, reveals the evidence of rubbing over the projections between the notches. The condition of the bones does not permit rough handling, but I have convinced myself that, when they were fresh, they not only might have been used for dance-timing, but were certainly so used.

In this connection I may refer to a paper by our fellow member Prof. Udden, upon an aboriginal village-site in Kansas. He mentions and describes a fragment of a similarly notched bone from our neighboring state. This he plainly prefers to consider a count record. It would be interesting to know whether it, too, shows the marks of rubbing.

My other example of notched rattle was found by an equal accident. I have just been spending some weeks among the Iroquois Indians of Central and Western New York. My Onondaga singer had been making some graphophone records for me and, after some hesitancy, had agreed to sing the death songs,—i. e. the songs sung in the house of death, while the game of moccasin is played. When he was ready, I went to his house to take the records and found, to my surprise, that he had prepared two pieces of fine grained, hard wood, for beating the time for his songs. One of these was a true notched rattle and the other was a rubbing stick. The latter was deeply cleft so that it really acted as two sticks. The effect of the use of this instrument was surprisingly good. It gave a sharp, loud, even beat, almost as regular as the beating of a drum or the sounding of a common rattle. On inquiring why I had never come upon this instrument before, I learned that it, the stick counters, and the other paraphernalia used in the death gambling game, are always burned at daybreak.

The occurrence of notched rattles in these two regions, so far distant from the localities already cited, appears to me of sufficient interest to warrant my thus calling your attention to it. (Read before the Academy November 29, 1901.)

NOTE.—If any doubt remained as to the Mexican notched bones being really the *omichicahauz*, it has now been removed by a recent, most interesting, find in the City of Mexico. In the course of conducting sewerage excavations, a great mass of objects was encountered back of the Cathedral, in Escalerillas street. These objects came from the great temple of the old Aztecs. Among them were a number of little objects made of

plain red pottery, which will be described shortly in an article in *The American Antiquarian*. They are miniatures of musical instruments and other objects used in dances. Apparently they were native offerings left in the temple. Among well known forms of drums, fifes, rattles, etc., are some notched bone rattles with the little spine of bone that was used in rubbing across the notches. One of these native notched rattles is shown in Fig. 3.

Fig. 1. Notched ribs from Wisconsin mound. (In the Academy's collection.)

Fig. 2. Wooden notched rattle used in the death songs among the New York Iroquois.

Fig. 3. Miniature, pottery, representation of notched bone rattle from Mexico. (In Mexican National Museum.)

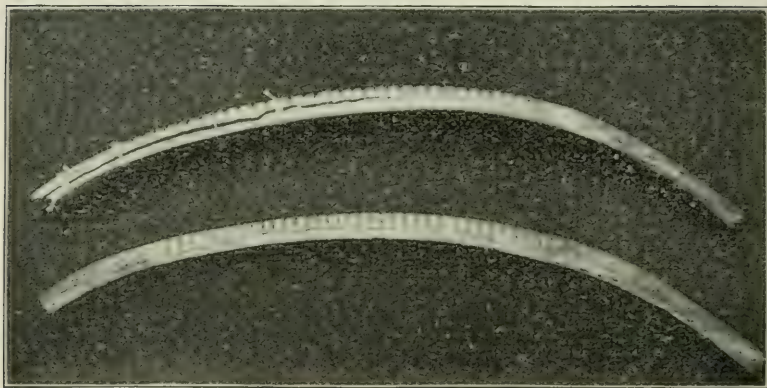


FIG. 1.

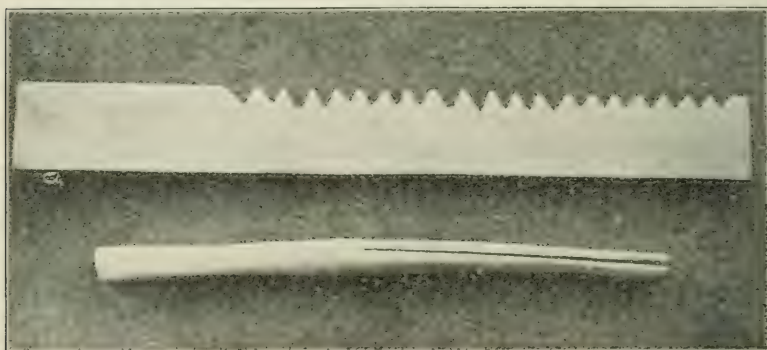


FIG. 2.

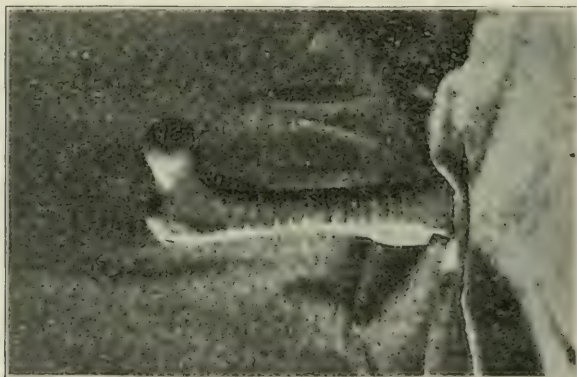


FIG. 3.

NOTCHED RATTLES FROM WISCONSIN, NEW YORK AND MEXICO

NORTH AMERICAN PHYLLOXERINÆ AFFECTING HICORIA (CARYA) AND OTHER TREES.

BY THEO. PERGANDE.

INTRODUCTION.

In the course of my studies of the Aphides of the United States, occupying more or less of my time during the past twenty-five years, I became much interested in our native Phylloxerinae as well as the curious galls or deformations produced by them, and have consequently made a few interesting observations, detailed in the present paper.

Early in the spring of 1889 the late Dr. C. V. Riley received a letter from Dr. Dreyfus, Wiesbaden, Germany, announcing his intention of monographing the *Uermes-inse* of the world, outlining his plan and progress of the work, accompanied by examples of the nature of the illustrations prepared for it, and urging Prof. Riley to assist him in this work with notes and figures of the species of Phylloxerinae occurring in North America on our native hickory trees.

Dr. Riley, at the time of the receipt of this communication, was in Paris, acting as the representative of the Secretary of Agriculture in connection with the installation of the American agricultural exhibit at the Universal Exposition of 1889, charged with the duties of Assistant Commissioner in Group 8. It was, therefore, out of the question for him to undertake the work himself, as desired by Dr. Dreyfus, and he directed the writer to draw up descriptions of all of the known and new species and to prepare the necessary drawings for the contemplated work. This work was at once taken up energetically and thoroughly.

In compliance with this request I restudied, as far as possible, all the previously described species, of which, fortunately, many

of the types, or typical specimens, or their galls had been preserved in Dr. Riley's private collection, now forming a part of the collection of Aphides of the United States National Museum, besides all those discovered by me, while studying this interesting group.

After the completion of these investigations and the numerous drawings by myself and Miss L. Sullivan, the manuscript was transmitted to Dr. Dreyfus in expectation of speedy publication. Unfortunately, however, it has been lying idle for these many years, with little or no prospect that it ever will be published, due, apparently, to financial and other troubles, which tend to postpone its publication indefinitely.

Under these circumstances and in justice to myself and in the interest of American students of entomology, I deem it proper to have this part of our Phylloxerinae published independently of Dr. Dreyfus.

Lacking time to study as thoroughly as possible the various species of this difficult though highly interesting group of plant-lice, I was able to work out the complete history of but one species, viz., *Phylloxera perniciosa* n. sp., which may be considered typical of the majority of the species inhabiting the different kinds of hickory.

All species of this group, as in many other gall-producing insects, hatch and form their galls at the earliest possible moment in spring, or, at about the time when the buds commence to burst and the young growth of twigs pushes out. After a leaf or section of a young twig has ceased its growth, no galls can be formed.

In accordance with this law of plant-growth there is, as a rule, but one series of gall-producing Phylloxerae each year, composed of the stem-mother, the migrants and the sexual generation, the latter producing eggs which remain dormant until the following spring, to start a new cycle of life. According to my observations there is at least one, *Phylloxera deplanata* n. sp., which differs remarkably from the rest, since the stem-mother frequently or more commonly produces no winged migrants, but directly the sexual generation, as observed by me during earlier studies. However, in the spring of 1902, when the galls of this species were extremely abundant on certain trees, I discovered also in a few of them, besides the stem-mother and sexed individuals, a few

migrants, whereas in the majority which were opened, only the stem-mother and sexes were found. In the case of another species numerous pupæ were found with the old mother and but two or a few winged migrants in but a very few galls; in all of these galls, occupied by the pupæ, were also observed large numbers of the sexes, as progeny of the pupæ; whereas in *Ph. c.-venæ* Fitch, all of the sexuparæ, which usually are winged, are wingless, resembling in this respect the stem-mother.

The conclusions arrived at are that, as a rule, the great majority of the species produce large numbers of the migratory form and that but few exist in which the stem-mother or pupæ are able to produce a sexed generation, and that but occasionally some migrants are developed to guard against the possibility of extermination.

Since the species treated of in this paper comprise but a fraction of those inhabiting the United States, there remains still a large field for fruitful investigation which may amply occupy a lifetime of those selecting it as a specialty.

In order to facilitate the study of the known species, inhabiting hickory trees, I have divided the various galls into groups, based principally on the location and shape of the galls on the parts infested.

SYNOPTICAL TABLE OF GALLS.

GROUP I. .

Galls thin, paper-like, more or less transparent.

The galls produced by the species of this group are quite variable, both in shape and coloration, and often difficult to separate, especially when several galls of closely related species grow upon the same leaf. So far twelve distinct forms belonging to this group have been discovered, of which seven have been found growing upon *Hicoria alleci* and *glabra* in the vicinity of Washington. The fully developed forms of most of them are quite readily separated, though intermediate or dwarfed forms occur frequently.

SECTION 1. *Opening above.*

1. Projecting more or less conically above and beneath; both nipples surrounded at apex by a fringe of long filaments.

Ph. c.-septum (Shimer).

Both cones very much elongated, slender and toothlike.

var. *perforans*, n. var.

2. Conical above, flat beneath; splitting into several bracts above when mature; with slender filaments at the centre beneath.

Ph. c.-foliae Fitch.

3. Similar to *c.-septum*; smaller, more flattened, but slightly convex above and beneath; opening round or oval, surrounded by short, recurved pubescent bracts; a minute closed nipple beneath *Ph. picta* n. sp.

4. Smaller, though similar to *c.-picta*; more convex, and often with a slight depression above; no opening above before maturity; a minute closed nipple beneath *Ph. intermedia* n. sp.

SECTION 2. *Opening beneath.*

5. Convex, more elevated above than beneath, with a reddish or crimson fovea or dimple above, varying in depth. The orifice beneath small and surrounded by a fringe of short, flat bracts..... *Ph. foveola* n. sp.
6. Concave above, convex beneath. The nipple formed of rather long, slender filaments. The depression above as well as the surface beneath, including the filaments, provided with long white hairs *Ph. pilosula* n. sp.
7. Size small, slightly convex above, more prominent beneath. Usually with a small, shallow depression toward one side, above. Nipple short, without bracts; the orifice more or less oval and fringed with short pubescence..... *Ph. deplanata* n. sp.

8. Size medium; slightly convex above and beneath, with a short nipple, having a round orifice, surrounded by a burr-like fringe of many filaments.....*Ph. depressa* (Shimer).
9. Size medium; quite flat above, with a dimpled depression, the opening beneath round and with a downy orifice.
Ph. foveata (Shimer).
10. Size medium; convex and considerably elevated above and more prominent than beneath; quite hard, smooth and shining. Orifice beneath round and closed. Resembling the galls of *Ph. c.-semen*.....*Ph. minima* (Shimer).
11. Minute; red, more convex and more prominent above than beneath, with a dimpled depression, The nipple short and surrounded by short, hairy bracts.....*Ph. c.-semen* Walsh.
12. Size medium; conical above and much more prominent than beneath; convex beneath, the nipple short, with an oval orifice, fringed with short hairs.....*Ph. c.-fallax* Riley.

SECTION I.

PHYLLOXERA CARYÆ-SEPTUM (Shimer).

Plate i., figs. 1-6; Plate ix., fig. 46.

Dactylosphæra c.-septum Shimer. Trans. Am. Ent. Soc., II., p. 389.*Phylloxera c.-septa* Riley. 7th Ann. Rep. Nox. & Ben. Ins. of Mo., p. 118.*Phylloxera c.-septa* Thomas. 8th Rep. Nox. & Ben. Ins. of Ill., p. 164.

The galls of this species, especially those of the more typical form, are the handsomest and largest of this group. Their transverse diameter at the plane of the leaf ranges from 5 to 12^{mm}. and their vertical diameter from 4 to 6^{mm}. They are quite convex on both sides and generally more conical and more prominently projecting above than beneath, especially so in the smaller specimens. All are provided with a nipple on both sides, the upper one stouter and more prominent, with its base more or less sunken below the plane of the gall. Both nipples, particularly the lower one, lean frequently somewhat towards one side. Both openings are either round or oval and fringed by about eight stout or slender filaments. The opening on the under side closes gradually so that the insects are compelled to leave from above. The consistency of the galls is dense, though rather thin, paper-like, and more or less transparent, crisp, and stoutest at the junction with the leaf. The cavity, if cut vertically, appears to be more or less hexagonal at the central portion, more or less pointed towards the nipples, and quite flat at the median circumference, with the exception of a ridge which indicates the former division of the gall into two compartments while young. The color above is variable. Some are of a darker or lighter bright red or pale rose, with a pale greenish margin around the base, while others are pale yellowish green, the nipple more or less brown, surrounded at base by a pale reddish ring. The color of the under side corresponds either more or less with that of the upper side or is of the same color as the leaf, or paler. In its younger stage, while still quite small, it is most beautiful and has very little resemblance to the fully grown gall.

STEM-MOTHER.—Length 0.6–1^{mm}; diameter across the thorax about 0.7^{mm}. Pyriform, the older ones shorter and more globular. Color pale yellow, the older specimens somewhat darker, with the head slightly dusky. Antennæ and legs blackish. Eyes small and dark purplish. Between the eyes are two small though rather deep dusky punctures or foveæ; two or three subdorsal dusky spots or punctures each side of the prothorax, and a more or less distinct, transverse, dusky spot each side in the sutures of the thoracic segments. Surface of body quite distinctly though rather sparsely and irregularly tuberculate, the tubercles minute and pointed, more numerous around the margin and denser and somewhat coarser on the head. Front of head gently arched and slightly notched at middle. Antennæ rather stout, joint 1 stoutest, about equal in diameter, longer than wide, rounded at apex; joint 2 somewhat longer and more slender, thinnest at base, the apex rounded and apparently divided by three to four quite distinct, scaly annulations; joint 3 much the longest, and divided by six or more rather coarse scaly annulations, its base forming, in some specimens, a distinctly thinner and well separated petiole.

EGG.—Length about 0.2^{mm}, regularly ovoid, white, polished and ornamented with regular, large, hexagonal facettes.

LARVA.—White or pale yellow, rather broadly ovoid, with stout antennæ and legs. Eyes red. Surface of body very sparsely and indistinctly granulate. Two transverse rows of minute dusky warts on the prothorax and a row of six similar warts on all other segments. Front of head quadrangulate, the angulations quite prominent, each bearing a short hair at tip. Rostrum long and stout, reaching beyond the end of the body.

PUPA.—Elongate, ovoid. Color orange, the head with a slight dusky tinge; meso- and meta-thorax paler, the wing pads and end of body almost white and with the external margin of the wing pads, especially in more mature individuals, blackish. Eyes brown, ocellar spots red or brownish. Antennæ and legs dusky. The whole surface of the body is densely covered with minute, conical, blackish points.

MIGRATORY OR WINGED FEMALE.—Length of body 0.8–1.2^{mm}. Expanse 2.4–3^{mm}. Color quite dark orange. Head, meso- and meta-thorax, scutellum and sternal plate black. Antennæ and

legs somewhat paler. Eyes dark brown or purple. Ocelli colorless, clear, bordered along the inner side by a broad, somewhat lunate, black margin. Prothorax marked with two transverse rows of three small and very pale dusky spots. Antennæ slender; basal joint shortest and stoutest, joint 2 somewhat longer, thinnest at base, the apex rounded and divided by five or six more or less distinctly scalloped or scaly annulations; joint 3 very long and slender, of almost uniform thickness, rather more than five times the length of the second joint, and usually slightly constricted at about its basal fourth; sharply and quite closely annulated, with the annulations more or less irregular; upper sensorial membrane about two-fifths the length of the joint, the lower one inconspicuous, small and rounded; apical nipple short, truncated at tip, bearing apparently two short, knobbed hairs. Legs rather long and slender. Body stout, covered with minute, obtuse tubercles, though less dense than in the pupa. Head and prothorax rugose and somewhat tuberculated, the rugosity more pronounced on the head. Wings large, broad and pale dusky; stigmata and venation darker; course of stigmal vein in many specimens abnormal, not entering the stigma but curving backward a short distance therefrom and connecting with the discoidal vein. This abnormality sometimes occurs in both wings and at others either in one or the other.

The first observations regarding this gall were made May 13, 1883, and, as it will help to throw some light on the question of the formation of this and many other galls, I will here include the few notes made at the time.

This gall, a very beautiful and curious object, I find, after a careful examination, to be nothing else but an abnormally great enlargement of a pore and the filaments or hairs surrounding same.

From the position of the galls, there can be no doubt whatever but that the young insect, as soon as it finds a suitable place, stations itself directly over a pore on the under side of a young leaf, into which it inserts its proboscis to extract the sap and to remain in this position. The irritation, caused by the sucking, gradually enlarges the pore so that the insect can sink into the opening; the rapid growing of the leaf causes the walls of the pore to prolong and the thus formed cell to widen till a regular cell is formed, enclosing the insect completely.

Remarkable it is, however, that the irritation is not confined to the lower side of the leaf but that it extends also to the upper surface, to the opposite pore, producing a counterpart of that on the underside. Both sides of the young gall at this stage are regularly conical and are fringed at the apex of each cone by about eight or nine very long, slender, backward curved, fleshy filaments which, when compared with the hairs surrounding the other pores, prove them to be identical though greatly enlarged. When some of the galls were opened it was found that they were divided horizontally by a delicate membrane into two compartments in the lower one of which the young stem-mother, already mature at this date, and surrounded by some eggs, had established her home. With her was also found but one cast skin, which seemed to indicate that several skins had been cast before the gall had formed and closed. The color of the young gall above is quite pale green with the filaments bright cherry or pink. The lower side is darker and the filaments white.

Two weeks later the galls had changed so completely in appearance that they could scarcely be recognized as belonging to the same species were it not for the filaments fringing the apex of the nipples, and even these were mere rudiments, much reduced by drying up. They were then fully mature and some of them already empty. When cut vertically it was observed that the dividing membrane had entirely disappeared, except the before-mentioned rudiment at the circumference.

PHYLLOXERA C.-SEPTUM, var. PERFORANS n. var.

Plate I., Figs. 7-8; Plate X., figs. 57-60.

A very conspicuous form of the above gall has been occasionally observed in the vicinity of Washington for several years past, occurring usually upon the leaves of *Hicoria glabra*, though always when already deserted. This same form had previously been observed by Dr. A. Fitch in the state of New York, also when deserted. In the place of the rightful occupants he discovered the imago and larvæ of a Phloeothrips, to which he gave the name of *Phloeothrips caryæ* (Third Rep. on the Nox. and Ben. Ins. of N. Y., p. 127, No. 165), which he, however, hesitated, and correctly so, to consider as the true architect of these singular galls.

During May of 1890 I have been fortunate, however, to discover

this form in fair abundance upon a single tree of *Hicoria glabra* growing near a small stream in the vicinity of Arlington, Virginia, and widely separated by hills and gullies from trees bearing the genuine or typical gall. They contained (May 16th) besides the other forms a considerable number of the winged migrants which proved, after careful examination and comparison, to be absolutely identical with those of *Ph. c.-septum*. The causes of this remarkable and constant variation are not readily explained except by the fact that the typical form has so far always been found upon young trees with large and succulent leaves of *Hicoria alba*, while those of *perforans* were upon trees of *Hicoria glabra* which had already attained a height of over twenty feet and with the leaves smaller and less succulent. As in the typical form, the gall is mostly single though now and then two, three or even more grow in close contact, generally close to the midrib, near its base, or near the stronger cross-ribs, and, instead of expanding horizontally, they become narrow and considerably elongated above and beneath, resembling a slender spur or nail forced through the leaf. The length of the cones varies from 3-8^{mm}. and the diameter at base from 2-4^{mm}. Both above and beneath, the cones usually lean to one side, those above usually in the opposite direction from those beneath, while cones growing near the edge of the leaf curve outwardly and often to such a degree that both points almost meet. Each cone splits into 6-8 slender bracts, fitting closely together and lined inside with a white, woolly pubescence.

At maturity the bracts of the upper cone separate to allow the insects to escape, while those on the under side remain closed. The inner structure of the galls is very similar to that of the typical form, though its walls are harder and thicker. Its color above and beneath is of a paler green than the surrounding leaf, inclining toward the apex to purple or brown. The transverse ribs between which these galls are stationed are, at the point of junction, often considerably angulated, much thickened and of a beautiful red or crimson color.

PHYLLONERA CARYÆFOLIÆ Fitch.

Plate II., fig. 9; Plate IX., fig. 47.

Phylloxera caryæfoliæ Fitch. Third Rep. Nox. and Ben. Ins. of N. Y., p. 446.

Phylloxera caryaefolia Riley. Seventh Ann. Rep. Nox. and Ben. Ins. of Mo., p. 117.

Phylloxera caryaefolia Thomas. Eighth Rep. Nox. and Ben. Ins. of Ills., p. 161.

Notwithstanding the apparently wide distribution of this species from New York to Illinois and as far south as Washington, it appears to be nowhere so common or so destructive as some of its near relatives. It is most noticeable during the latter part of May on the leaves of *Hicoria glabra*, and though usually there is but a single gall upon a leaf, as many as four may sometimes be found. Some which were studied on the 23d of May along the Potomac River in Virginia contained already quite a number of winged migrants, though the gall had not yet sufficiently opened at the apex to allow the inmates to escape.

The principal part of the gall is always on the upper side of the leaf and represents a regular, slender cone which often leans slightly over to one side. The transeverse diameter of the gall at the base of the cone is about 3^{mm}. and, including the pale ring surrounding it, about 5^{mm}.; and its vertical diameter is also about 5^{mm}. Its surface is more or less pubescent, more densely so beyond the middle. Its color above is pale green, with numerous still paler, extremely fine, radiating lines running from tip to base. The apex is either somewhat yellowish, pale brownish or pale purplish and the extreme base darker green. The ring surrounding its base is either somewhat projecting and slightly convex or sometimes depressed or saucer-like and of a yellow or greenish-yellow color. The under side of the gall is but slightly projecting and quite flat, with a small elevated ring surrounding a minute central depression from which rises a small nipple, splitting into a number of very fine and slender pubescent filaments. The walls of this gall are very thin and flexible and rather difficult to tear, especially when they commence to shrivel after having been taken off the tree for some time. They are stoutest at base and more or less transparent if held towards the light. That this species is closely related to *Ph. c.-septum* is quite apparent. The younger ones have also, as in that species, a transverse membrane which gradually disappears, leaving a distinct rim to indicate its position.

STEM-MOTHER.—Length about 0.6^{mm}. Shape broadly ovoid or almost globular. Color greenish yellow with a faint dusky tinge. Antennæ and legs blackish, eyes purplish-black. There are two small dusky spots near the front of the head and three at its posterior margin. One or two dusky subdorsal and one lateral spot each side anteriorly, and one transverse subdorsal and a lateral spot each side posteriorly beyond the middle, on the prothorax; also a subdorsal and lateral spot in the sutures of the two following segments. Surface of body densely covered with minute points and sparsely and irregularly tuberculated. Antennæ very short, the third joint somewhat thinnest towards its base, and sparsely annulated.

EGGS and LARVÆ white.

PUPA.—Orange; eyes brown, ocellar spots red, antennæ and legs dusky; wing pads whitish, sometimes pale dusky or with the external margin or the tip dusky. Surface of body densely granulate. Antennæ slender, the third joint at least three times the length of the two basal joints combined.

MIGRATORY FEMALE.—Length of body 0.8-1^{mm}. Expanse of wings 2.6-2.8^{mm}. Slender. Color orange, the prothorax darkest, the end of the abdomen palest. Head, mesothorax, scutellum and sternum blackish or brownish, the head often orange with a dusky tinge, and blackish anteriorly. Antennæ and legs dusky. The prothorax is marked with two more or less distinct, large, transverse dusky spots or bands, one near the anterior margin and the other beyond the middle, with three small blackish punctures, arranged in an oblique, curved row each side of the posterior band. The sides are also broadly dusky. Surface of body distinctly and quite densely granulate. Antennæ slender and rather longer than the head, with joint 1 scarcely longer than wide and somewhat stoutest at base, with its apex truncate; joint 2 slightly longer than wide, thinnest at base and rounded at apex; both joints but sparsely annulated, joint 3 rather more than three times the length of the others combined, very slender and with about thirty closely placed, sharp and scaly annulations.

It approaches *Ph. devastatrix* n. sp., though the third antennal joint is still more slender, with the lower sensorial membrane placed higher up and the upper one longer, the former a little

above the basal one-fourth, is rather small and but little projecting, while the latter is about as long as the basal section below the indentation; the differences in the galls will, however, readily separate the two. *Ph. devastatrix* forms a stem- or bud-gall approaching that of *perniciosa*, whilst this forms a leaf-gall approaching that of *c.-septum*. It comes also very near *c.-intermedia*, to which it appears to be most closely related, though the galls have no resemblance to each other.

PHYLLOXERA PICTA Pergande, n. sp.

Pl. II., fig. 10; Pl. IX., fig. 48; Pl. X., figs. 61-63.

The galls of this species resemble very much those of *c.-septum*, though ordinarily smaller, much more flattened, and to all appearances entirely destitute of a dividing membrane. The insects are also smaller and paler and exhibit some characters which tend to separate it from that species.

The transverse diameter of the gall varies between 3-6^{mm}. and the vertical diameter between 2-3^{mm}. It is quite flat on both sides, though somewhat more elevated and more convex on the upper, with a more or less distinctly depressed ring surrounding the base of the nipple. Both sides of the gall are provided with a short, conical nipple, each closed till maturity, and furnished inside and generally also at the tip with fine pale hairs. The lower nipple always remains closed, while the upper opens in a round or oval mouth, split into several very short, recurved bracts covered with fine pubescence. The walls of this gall are very thin and semi-transparent so that the insects can be seen moving about if held towards the light. The color is variable. Some are quite dark-green with a faint purplish shade and with the nipple and a ring around its base dark red. Others are of the color of the leaf or slightly paler, with a faint purplish ring surrounding them, the nipple and the depression surrounding its base pale buff or pale clay-yellow. Another variety is more or less pink, its margin yellowish or concolorous with the leaf. Still others are pale greenish-yellow with a faint purple ring surrounding the still darker nipple, besides many other variations. The under side is uniformly paler than the leaf and the nipple yellowish.

It occurs on *Hicoria tomentosa* and matures by the end of May or early June.

To separate this gall from many of the forms of *Ph. intermedia* is often very difficult, especially after they have burst open, when they resemble each other quite closely, though a comparison of the winged forms of both will show them to be unmistakably good species.

STEM-MOTHER.—Length 0.5^{mm}. Almost globular, pale-yellow, the oldest ones darker and with a faintly dusky tinge. Legs and antennæ pale-dusky and rather stout. Eyes purplish-black. Antennæ short and rather stout; the third joint somewhat clavate, slightly curved, quite pointed beyond the minute thumb and but sparsely annulate. The surface of the whole body is closely covered with large, round tubercles.

PUPA.—Varying from nearly white to various shades of yellow. Antennæ and legs faintly dusky; the wingpads whitish with a dusky external margin. Eyes and ocellar spots reddish. The whole surface of the body is distinctly and densely granulate. Antennæ slender; the third joint of about uniform thickness and with scarcely a trace of annulation.

MIGRATORY FEMALE.—Length of body 0.8–1.3^{mm}. Expanse of wings 2–2.6^{mm}. Color pale orange. Head, mesothorax, scutellum and sternal plate varying from dusky, to almost black. Antennæ and legs faintly dusky. Ocelli clear, margined at inner side with black. Form rather slender, the abdomen often considerably elongated. Head and prothorax finely rugose, the sculpturing much finer than in *c.-septum*. Abdomen indistinctly granulate. Antennæ slender and very similar in shape to those of *c.-septum*; joint 2 somewhat longer than the first, thinnest at base, rounded at apex and divided by 3–4 apparently scaly annulations; joint 3 of almost uniform thickness, slightly constricted just above the lower sensorial membrane, its basal section being about the length of joint 2, and sharply and coarsely annulate; the upper sensorial membrane attains almost one-half the length of the joint, whereas the lower one is inconspicuous, small and round. The whole appearance of this joint, in the main, is very similar to that of *c.-septum*. Wings delicate and pale dusky, the veins slightly darker though often almost

obsolete. Stigma distinct. The stigmal vein straight and normal in its course, exhibiting no tendency to connect with the discoidal vein.

PHYLLOXERA INTERMEDIA Pergande, n. sp.

Pl. II, figs. 11-14; Pl. X., figs. 64-65.

The gall of this species appears to be intermediate between *Ph. c.-septum* and *Ph. picta*. Its inner construction resembles that of *c.-septum* on account of the presence of a rudiment of the central membrane, though its general form, especially in the larger specimens, is more like that of *picta*, from which, however, it differs in the much thicker walls and the absence of a nipple on the upper side.

The transverse diameter of this gall varies between 3 and 6^{mm}. and its vertical diameter between 2 and 3^{mm}. The shape above is regularly convex in the larger galls and slightly conical in the smaller ones, and without a trace of a nipple or opening before maturity. On the under side it projects but slightly and is provided with a minute, but closed nipple, the insect issuing from the upper surface which splits in a more or less jagged, round or oval opening, the bracts of which curve more or less outward. In some few cases the nipple on the under side also opens sufficiently to allow the insects to emerge from both sides. The color of the galls above is reddish or yellowish, generally surrounded by a paler ring, and beneath paler than the leaf. It occurs on *Hicoria alba* in company with the other two, and matures from the end of May to the middle of June.

MIGRATORY FEMALE.—Length of body 0.8-1.3^{mm}. Expanse 1.6-2.4^{mm}. Color pale orange, palest toward the end of the body, the prothorax darkest. Head, antennæ and legs dusky, the metathorax and scutellum darker, the sternal plate black. The prothorax is more or less distinctly marked, mediodorsally, with a small, transverse, dusky spot and bordered each side with a dusky shade. Antennæ rather more slender than in the other two species, about as long as the tibiae and apparently composed of four joints, the third joint in most of the specimens being distinctly and sharply divided just above the lower sensorial membrane. The annulations are rather shallow and in some specimens difficult to detect. There is, however, more or less

variation in the length and prominence of the third joint, which is often much shorter than represented in the figure; or it may be longer in one antenna and shorter in the other, resembling in the latter respect more *Ph. picta*. Wings delicate, faintly dusky or almost colorless and rather short; stigma dusky, with a yellowish tinge or sometimes almost colorless; veins very delicate, especially the discoidal and stigmal veins, both of which are often difficult to discern; the stigmal vein in some specimens connects with the stigma in both wings, in others either in the right or left wing only; whereas in others one or both veins curve away from the stigma to connect with the third discoidal vein, resembling in this respect *c.-septum*, from which it differs, however, in its smaller and paler wings and venation, the paler and almost smooth body and the more slender antennæ.

SECTION II.

PHYLLOXERA FOVEOLA Pergande, n. sp.

Plate III., figs. 15, 16.

The gall of this beautiful species is evidently closely related to and may possibly be identical with *Ph. foveata* Shimer (Trans. Am. Ent. Soc., II., p. 393), but considering the number of closely allied species in which the galls resemble each other more or less closely, and the fact that the inmates of his galls were winged and plentiful by the 20th of June at Mt. Carroll, Ill., whereas the galls of *foveola* are nearly deserted by the 1st of June, near Washington, induce me to consider the two forms as specifically different.

I have found this gall during the latter part of May upon *Hicoria glabra* in the vicinity of a small creek between Arlington, Va., and the Potomac River. Most of the galls contained, as early as May 23rd, numbers of the winged form. These galls grew either singly or as many as forty upon a single leaf when they become at times confluent, each retaining, however, its character and individual cell intact. On some of the trees they were much more numerous, completely covering some of the leaves. The diameter of the galls ranges more or less between 3-5^{mm} horizontally and between 1-3^{mm} vertically. They are as a rule very

convex and more prominent above than beneath, with a rather deep dimple or depression at the centre, which depression occasionally reaches as far down as to the opposite side of the gall; its basal circumference forms either a depressed or elevated ring. Beneath they are but slightly convex, often sunken below the plane of the leaf, with the centre depressed and bearing a very short, somewhat conical nipple, which is tightly closed and densely covered on the inside with a pale pubescence in the younger galls, whereas in the older or mature galls the nipple splits into 4-8, or rarely more, short and rather flat recurved bracts, which leave a round or slightly oval orifice between them.

In the largest and perfectly developed galls the upper side is either of a delicate pale red with the dimple darker and its basal circumference yellowish-green; or entirely yellowish-green with only the dimple of a beautiful pink color. Beneath they are uniformly yellowish-green, often with a faint reddish tinge, especially toward the nipple. On the other trees, most densely covered by them, they were less beautiful, with less red and a shallower dimple. The walls are very thin and paper-like and readily collapse when old. All galls are perfectly smooth on both sides.

STEM-MOTHER.—One of the smallest so far observed. Length 0.4-0.6^{mm}. Broadly ovoid, pointed posteriorly. Color yellow or pale orange. Antennæ and legs dusky, eyes black. Antennæ very short, the third joint being scarcely longer than the two basal joints combined, and rather thin; joint 1 much the stoutest, about as long as wide, and truncated at apex; joint 2 longer than wide, stoutest and rounded at apex; joint 3 slender, somewhat curved, with 8-10 irregular and coarse annulations; the thumb short but distinctly projecting; two to three fine hairs surrounding the tip. Front of head straight or slightly concave. Granulation of body extremely fine and quite dense.

EGG.—White, with a faint yellowish tinge, regularly ovoid, highly polished and quite profusely reticulate.

LARVA.—White; legs and antennæ pale dusky; eyes red. Six prominent conical tubercles along the front edge of head, each furnished with a fine hair. Surface of body finely granulate. Antennæ longer than usual, the third joint stoutest at middle,

tapering towards both ends and, apparently, with twelve shallow annulations, the thumb small and at some distance from the apex of the joint. Rostrum extremely long, reaching about one-half its length beyond the abdomen.

PUPA.—The younger pupæ are whitish and the larger pale orange, the wingpads and mesothorax whitish, the former often with a blackish external margin, and the latter with the two median lobes faintly dusky or greenish. The head darkest and the end of the body palest. Surface of body quite densely and coarsely granulate. Eyes brown, ocellar spots red. Antennæ rather long and stout.

MIGRATORY FEMALE.—Length of body quite uniformly 1.2^{mm}; expanse of wings about 2.8^{mm}. Form slender, much more so than in most species. Color orange, varying in depth, the prothorax darkest. Head black; in the younger ones dusky with only the front edge black. Eyes brown, ocelli clear, bordered with black at inner edge. Antennæ blackish. Legs dusky with a yellow tinge, and rather slender. Mesothorax, scutellum and sternal plate black or dark brown. There is a poorly defined, more or less dusky band or shade across the prothorax, two ill-defined dusky spots near anterior margin, with more or less distinctly dusky anterior angles, and sometimes a blackish subdorsal spot each side in the dusky median band. Front of head straight or slightly concave. Antennæ slender, the first joint about as long as wide, slightly stoutest at base, truncate at tip, with but feeble indications of annulation. The second is slightly longer than wide, thinnest at base, rounded at apex, and rather coarsely scaly or annulated. The third is about three times the length of the two basal joints combined; it is slender and of almost equal diameter throughout, with the upper sensorial membrane about one-half the length of the joint; the lower one is minute, often apparently wanting, and close to the base of the joint, resembling in this respect those of *Ph. c.-arellana*. The lower part of the joint, as far as the upper sensorium, is rather coarsely annulated, and the upper part scaly. Wings long and narrow and faintly dusky. Stigma and costal cell dusky with the stigma not well separated from the cell. Subcosta and veins blackish, the latter bordered with a dusky

shade; the two branches are much farther apart than is usual, on account of the stigmal vein, which is far removed to the apex of the stigma. The bases of both branches are often completely obliterated and without a connection with either the discoidal or the stigma.

PHYLLOXERA PILOSULA Pergande, n. sp.

Pl. III., fig. 17; Pl. IX., fig. 49.

The galls of this species are very unique and readily distinguished from any others so far observed. They occur usually on solitary trees of *Hicoria glabra* along the Potomac near Washington. They are usually quite abundant though rather sparsely distributed, there being but one, or rarely more than 3-6, upon a leaf and seldom so close together as to become confluent.

When first found, May 23rd, they were already fully developed, but contained, besides the stem-mother, only eggs and larvæ. Ten days later most of the insects had already acquired wings.

The transverse diameter of the gall varies between 3-6^{mm}, and their height to the tip of the nipple 2-3^{mm}. They are quite flat above, even with the surface of the leaf or but slightly projecting above it. In the latter case they are usually surrounded by a somewhat depressed ring and have a slight inclination to one side. There is always a more or less distinct shallow depression at the middle, which is usually quite densely covered with rather long, faintly yellowish, soft and glistening hairs. On the under side they resemble somewhat those of the variety *Ph. c.-symmetrica*, though they are more evenly convex and provided with a rather long and slender nipple, which is split into five to six, or rarely more, slender filaments, which usually lean to one side. This nipple, as well as the surface of the gall, is quite densely covered with long, glistening and faintly yellowish hairs similar to those on the upper surface. This pilosity of the gall is quite in contrast with the otherwise perfect smoothness of the leaves above and beneath. The upper side of the galls is of a paler green than the leaf itself, with a slight tinge of yellow, whilst on the underside the color merges gradually from pale green at its circumference to almost white at the nipple. The walls are quite

solid and rather stout at the base. The galls are almost perfectly white on the inside and semi-transparent.

STEM-MOTHER.—Length about 0.8^{mm} . Shape broadly oval, the last two or three segments quite slender. Color pale dull yellowish, with a faintly dusky tinge. Head, antennæ and legs dusky. Eyes brown. Surface of body apparently without granulation. There are two small blackish median punctures on the head, between the eyes; six stiff hairs along its front edge, a transverse row of four such hairs back of the anterior margin, one each side of the black punctures, and one close to the inner edge of the eyes. Two similar hairs, arising from lateral tubercles of each of the thoracic segments and one each side, also on tubercles, on the abdominal segments. The dorsum is marked with six rows of pale dusky tubercles, each bearing a hair, with two deep subdorsal punctures each side of the prothorax, and two similar punctures each side in the following three sutures. Antennæ rather short; the first joint very much swollen and almost globular. The second slightly longer than wide, rounded and somewhat stoutest at apex. The third not much longer than the two basal joints together, of equal diameter throughout and quite scaly. Legs rather longer than usual, the tarsi very stout, conical, with the knobs of the terminal hairs larger than usual.

The stem-mother of this species is more active than that of any of the other observed species.

EGGS.—Pure white, ovoid, highly polished and with a faint trace of hexagonal reticulations.

LARVA and youngest pupæ white, the older ones pale orange: mesothorax and wing-cases white. Eyes and ocelli red. Antennæ and legs white. Surface of body densely and quite coarsely granulate.

MIGRATORY FEMALE.—Length of body about 1.2^{mm} . Expanse of wings $2.8-3^{\text{mm}}$. Color orange, the prothorax darkest. Head blackish, its anterior margin darker. Eyes brown, ocelli clear, bordered with black at inner margin. Antennæ and legs pale dusky. Mesothorax, scutellum and sternal plate black. The prothorax is marked at its anterior margin with a median, somewhat elongated, triangular, pale dusky spot and a short trans-

verse subdorsal line each side of it; a short, oblique or curved line subdorsally each side, often broken into two or three spots, and a slightly dusky, median shade at posterior margin. Surface of body sparsely and finely tubercled. Antennæ short, scarcely as long as the head is wide posteriorly; joint 1 stoutest, about as long as wide and of about equal thickness. The second but faintly longer than wide, rounded and a little stoutest at apex. Both joints are distinctly scaly and annulated. The third joint is of about equal thickness throughout, with the upper sensorial membrane very long, occupying two-thirds or more of the joint, the lower one being entirely wanting. The upper two-thirds of the joint, or more, is quite coarsely scaly and the lower part divided by about ten annulations; the apex is blunt and provided with one hair at tip and two others a little below it. Legs rather slender, the tibiæ annulated and the terminal pair of capitate hairs longer than usual, and the knob more distinct. The body ends, above, in a stout and prominent conical anal projection which is not uncommon in other Aphididæ, but is not ordinarily conspicuous in Phylloxeridæ. The vulva is also very prominent, expanding trumpet-fashion, and with its external surface closely and beautifully striated. Wings large, pale, though with a dusky hue and with their surface densely scaly; stigma, subcosta and veins dusky, the latter shaded. Venation normal, though the stigmal branch reaches seldom to the stigma, but fades away some distance before it.

The winged form approaches quite closely that of *Ph. foveola*, more particularly in the antennæ, the third joint of which in that species is also quite uniform in diameter. The absence of the lower antennal sensorium, the more slender form, and the differences in the stem-mother and the gall, all serve to separate the two forms.

PHYLLOXERA DEPLANATA Pergande, n. sp.

Pl. III., figs. 18-20; Pl. IV., figs. 21-23; Pl. X., figs. 66-70.

The galls of this species and their architects were carefully studied in 1883 on some small trees of *Hicoria tomentosa* growing on a hilly slope, bordering the Potomac River, opposite Georgetown, D. C. An interesting fact connected with the species was

the absence of the winged or migratory generation, in which respect it agrees with *Ph. c.-semen* Walsh and *Ph. caryæ-venæ* Fitch. That *Ph. deplanata* is distinct from this last is made patent by a comparison of the galls and stem-mother; while it would also seem to be distinct from *Ph. c.-semen*, its western representative. The galls of *Ph. c.-semen* are the smallest known, measuring not more than 0.6-2^{mm}. horizontally, being more or less subglobular and provided with a round orifice, surrounded by a fringe of 5-8 or more, rather broad bracts; whereas the galls of this species have a transverse diameter of 1-5^{mm}, are but slightly convex above and more prominent beneath; the orifice is oval and without any bracts, but closely fringed with fine hairs. Its walls are rather thin and flexible, while those of *Ph. c.-semen* are thick and hard. In how far the insects of these two galls differ is not at present known, but there is little doubt that future more careful study of Walsh's species will reveal sufficient differences.

The leaves of some of the smaller trees are often literally covered with the galls of *deplanata* which then produce a sickly, yellowish and crumpled appearance thereof. By the end of June the galls are deserted, brown and dry, or else have completely decayed, leaving innumerable holes in the affected leaves, seriously affecting the health of the tree. When but a few days old (first week in May) these galls resemble minute yellow specks.

The transverse diameter of the mature galls varies from 1-5^{mm}; height about 1^{mm}; walls rather thin above and beneath and semi-transparent. Upper surface projecting but little above the plane of the leaf, convex, usually with a shallow fovea; frequently not central and occasionally with a slight central elevation. Under side more strongly convex, sometimes almost conical, the nipple usually more or less flattened and generally leaning to one side, as if pressed down when young; with the orifice usually oval, though sometimes more or less rounded, and which before maturity is perfectly closed and densely fringed with short pale hairs. Color above either reddish with the depression yellowish, or almost entirely greenish-yellow; below purplish or dull greenish-yellow. Many of the galls are conjoint, *i. e.*, contain from 2-6 or more

stem-mothers together with large numbers of eggs and sexual individuals, the cavity being completely crowded.

STEM-MOTHER.—Length of body $0.4-0.5^{\text{mm}}$ and almost as broad. Color, varying shades of orange. Antennæ, legs and rostrum faintly dusky, almost colorless. Eyes dark-purple or black and each composed of three simple ocelli. The whole body is densely covered with distinct, minute, conical tubercles. Head about twice as broad as long, almost semi-circular, slightly flattened between the antennæ and furnished each side just in front of the eyes with a peculiar, rather prominent, more or less conical, fleshy, colorless and apparently retractile, protuberance. Antennæ quite slender, the first joint of almost equal thickness; the second shorter than the first, thinnest at base, truncate at tip. Joint 3 long and slender and somewhat stoutest beyond the middle, with eighteen or more sharp annulations more or less well defined. Legs quite stout, the tibiæ distinctly clavate. Anus bluntly rounded and apparently furnished with four hairs around its edge.

EGGS.—Length $0.1-0.2^{\text{mm}}$. Ovoid, polished and pale yellow, the more recently laid, whitish. The smaller produce males.

SEXUAL FORM, ♂ ♀.—Length of the female 0.4^{mm} , the male being about one-sixth smaller. Color pale yellow, head, antennæ, legs and a rather indistinct band across all segments pale dusky. Eyes dark purple or purplish-red, composed of three large ocelli arranged in a triangle. Surface of whole body covered with very minute conical tubercles and with four dorsal and one lateral row of larger warts on the thorax and abdomen and quite a number on the head, each bearing a slender hair, which, in the female, is simple, but capitate and stouter in the male. A minute conical rudiment of the rostrum in both sexes, not fitted for sucking. A somewhat prominent round tubercle on each side of the pro- and metathorax. The antennæ are quite slender; the first joint stoutest; joint 2 longer than wide. Annulation of third joint rather indistinct and irregular. The thumb-like organ near the tip is quite prominent and has been observed to be distinctly movable. The tips of the thumb and of the joint are furnished with several exceedingly fine hairs, the terminal one, as well as that at the tip of the thumb, in the male, being capitate. Legs

rather short. The body of the male, besides being smaller, is almost of equal diameter throughout, while the female is broader and elongate-ovoid.

Both sexes are very active and run briskly about after leaving the galls, particularly the males.

During May of 1902 I happened again to observe the galls of this species to be quite numerous on the leaves of *Hicoria* (*Carya*) *microcarpa* and found on examination that each of the galls contained from one to five or more of the stem-mothers, their eggs and the sexes, and, to my surprise, found also a number of pupæ and winged migrants in some of them; which proves that the habitually apterous species evolves from time to time a migratory form, to preserve the species against extermination.

The migrant is orange; the head, antennæ, thoracic lobes, sternal plate and legs dusky to black; the wings are dusky. The antennæ are evidently four-jointed, the fourth joint is distinctly petiolated, with the petiole being divided by three to eight or more sharp annulations; the sensorium of joints three or four being very much elongated.

PHYLLOXERA DEPRESSA Shimer.

Dactylosphæra depressum Shimer. Trans. Am. Ent. Soc., 2, pp. 389-390.

Phylloxera depressa Riley. Seventh Rep. Nox. and Ben. Ins. of Mo., p. 118.

Phylloxera depressa Thomas. Eighth Rep. Nox. and Ben. Ins. of Ills., p. 164.

Not having had an opportunity of seeing this gall, I am unable to form an opinion as to its specific value and reproduce, therefore, the description as given by Shimer:

"These galls were found to be exceedingly numerous on some trees [*Carya alba*]. On June 20th they were smooth, slightly rounded above, pale yellowish-green; beneath somewhat whiter, and having in the centre a nipple-like projection; opening round, surrounded with a burr-like fringe composed of many filaments, the cavity like an inverted cone, the wall above being quite thin and translucent, so that the inmates may be seen moving about. This apparently very flat gall was placed as much below as above

the plane of the leaf. Diameter .15-.25 inch [3.8-6.2^{mm}.]; vertical thickness .125 inch [3^{mm}.].

"Winged imago. Yellow; head, antennæ, legs and a band around the thorax, black; antennæ 3-jointed; otherwise as in specimens from gall No. 1 [*Ph. hemisphericum* Shimer]. Length of body .04 [1^{mm}.]; to tip of wing .06 inch [1.5^{mm}.]."

PHYLLOXERA FOVEATA Shimer.

Dactylosphæra foveatum Shimer. Trans. Am. Ent. Soc., 2, p. 393.

Phylloxera foveata Riley. Seventh Rep. Nox. and Ben. Ins. of Mo., p. 118.

Phylloxera foveata Thomas. Eighth Rep. Nox. and Ben. Ins. Ills., p. 164.

This appears to be nearest related to *Ph. foveola* n. sp. and *Ph. intermedia* n. sp., though as no opportunity has offered to further study *foveatum* at Washington, Shimer's original description is reproduced:

"On the same leaves [of *Carya amara*] containing the small galls, Nos. 7 [*Ph. minimum* Shimer] and 8 [*Ph. c.-semen* Walsh], I observed a number of larger ones with a dimpled depression above (which may be caused by the collapse of the thin paper-like centre), an opening beneath by a rounded, downy orifice, and having a diameter of .06-.33 inch [1.5^{mm}.] and a vertical depth of .12-.16 inch [3-4^{mm}.]; all contained the female and her eggs, and some larvæ.

"Winged imago.—Abdomen and prothorax pale orange, with a dark band or ring around the mesothorax; wings carried flat on the back in repose, hyaline, veins small, stigma very faint, smoky; antennæ 3-jointed, the last joint long, subcylindrical and on a very long pedicel; abdomen quite pointed. Length to tip of wings .06 [1.5^{mm}.]; of antennæ .005 inch [0.1^{mm}.].

"Mother insect.—Pale yellow, palest posteriorly. Length .04 [1^{mm}.]; width .2 inch [0.05^{mm}.].

"On June 20th the winged imagos were very plenty, but no eggs could be found."

[As printed in Trans. of the Am. Ent. Soc., Vol. 11, p. 393, the name of this species reads *Dactylosphæra foveatum* and not *foveatum*, as used by Riley, Thomas, and others. The word as used in the Transactions is evidently a misprint which originally read *foveatum*, with reference to the dimpled depressions on the upper side of the leaf. The corrected spelling is used in the index to the volume. I deem it, therefore, proper to correct those errors.]—THEO. P.

PHYLLOXERA MINIMUM Shimer.

Dactylosphæra minimum Shimer. Trans. Am. Ent. Soc., 2, pp. 391-2.

Shimer's original description is as follows :

" Small round galls, generally very numerous in the leaves, and in some cases almost entirely covering them, a single leaf sometimes containing upwards of 250 galls; the average size larger than those of No. 8 [*Ph. foecatum* Shimer], although often quite as small, the larger ones measuring three-sixteenths of an inch [5^{mm}] in diameter. They were (June 25th) quite hard and smooth, and present, especially above, a bright, shining appearance; they were quite thick and plump, the vertical diameter compared with the horizontal diameter being as 2 to 3, and were much more plump and elevated above the leaf than those of No. 8 [*Ph. carya-semen* Walsh]. The portions of the leaf between the galls had in some cases turned crimson. I found from three to twenty-five inhabitants in a gall; the round opening beneath was so close as to be pretty safe against enemies, as I found none in the galls opened thus far. Larvæ and pupæ whitish, with red eyes; mother insect cinnamon color and smaller than the pupa.

" On July 5th I found winged imagos in all the galls, large and small, that were opened, the smallest galls not much exceeding .05 inch [1^{mm}] in diameter: when opened, the young insects eagerly ran out, and all presented the same pale, translucent appearance, with minute dark spots on the anterior part of the body, which is in contrast with the inhabitants of gall No. 8. The winged imago was first observed on June 30th.

" Winged imago.—Body, antennæ and legs, pale yellowish-white; the head and a band around the thorax, dusky; wings on the back in repose, translucent, venuration obsolete, the stigma scarcely perceptible. Length of body .025-.03 [$0.6-0.8^{\text{mm}}$]; to end of wings .045-.05 inch [$1-1.1^{\text{mm}}$].

" These insects are much smaller, paler in color and less disposed to fly than any of the other species noticed in this paper. From a gall .05 inch [1.1^{mm}] in diameter, I took a single winged imago with body .025 inch [0.6^{mm}] in length: with it there were a few eggs, but no other insect. I verified this same circumstance in several other small galls of this species, and it therefore appears

probable that the winged imago was the mother insect, developed into the winged state, although we have heretofore considered them as males."

PHYLLOXERA CARYÆ-SEMEN Walsh.

Pl. IX., figs, 50-51.

Phylloxera caryæ-semen Walsh. Proc. Ent. Soc. Phil., VI., p. 283.

Daktylosphæra caryæ-semen Walsh. First Ann. Rep. Nox. Ins. of Ills., p. 231.

Daktylosphæra caryæ-semen Shimer. Trans. Am. Ent. Soc., 2, p. 392.

Phylloxera caryæ-semen Riley. Seventh Rep. Nox. and Ben. Ins. of Mo., p. 117.

Phylloxera caryæ-semen Thomas. Eighth Rep. Nox. and Ben. Ins. of Ills., p. 163.

This is evidently closely related to *Ph. deplanata*. The galls of *c.-semen* are, however, much smaller, more strongly convex, projecting above, and of much finer and harder texture. They also greatly resemble smaller specimens of *Ph. minima* notwithstanding the striking difference in the life-history of the two species, viz.: the production of a winged, migratory form in *Ph. minima* and the absence of such in *Ph. c.-semen*.

Walsh (Proc. Ent. Soc. Phil., 6, pp. 283 and 284) was led from the apterous nature of the species to consider it Coccidous rather than Aphidian, and in discussing the relative generic value of winged and apterous gall-making species, remarks that "*Carya* possesses at least two Coccidous galls, namely, *caryæ-venæ* Fitch, which I find exclusively on the Shell-bark Hickory in August, and which is described by Fitch as Aphidian, and doubtingly referred to the genus *Pemphigus*, and *caryæ semen* Walsh MS., a gall of the size and shape of a cabbage seed, which I find in prodigious numbers on the leaflets of the Pig-nut Hickory in July." And further on, in a foot note, he says: "That these two galls are Coccidous, not Aphidian, may be inferred from the fact that the tarsi of the mother-lice are 1-jointed, not 2-jointed. And besides,

Dr. Fitch himself describes the mother-lice of *caryæ-semen* as laying eggs, and the same remark applies to those of *Caryæ semen*; whereas all true gall-making Aphidians that are known to me are viviparous so long as they live in the gall. Moreover, all gall-making Aphidians that are known to me remain in the gall till they have reached maturity and most of them acquired wings; whereas in these two galls the young larvæ, almost as soon as they have hatched out, stray away to found new galls, leaving the mother-lice behind them to lay from time to time fresh eggs."

With our present knowledge of the Phylloxerinae we know that Walsh erred in forming this opinion. The tarsi of both species mentioned are like those of all other known species of Phylloxera plainly 2-jointed, he having simply overlooked the small basal joint: while the economy of the species producing winged females shows that they all originate from eggs, numerously deposited by the stem-mother on the walls of the gall. Maintaining this erroneous position regarding the Coccidous character of *c.-semen*, he refers it later (First Ann. Rep. Nox. Ins. of Ills., p. 23) to Shimer's genus *Dactylosphæra*, to include all those species which produce, or are supposed to produce, nothing but apterous individuals and proposed for all others, producing a winged generation, the name of *Nerophylla* Proc. Ent. Soc. Phil., VI., p. 283, and 1st Rep. Nox. Ins. of Ills., p. 23. In the latter publication, after much discussion, he gives a short description of the gall and its architects on page 23, as follows:

"Gall *Caryæ-semen*, n. sp. made by *Dactylosphæra caryæ-semen*, new species. On the general surface of the leaflets of the Pig-nut Hickory (*Carya glabra*) in prodigious abundance, a subglobular, smooth, seed-like, hollow, sessile gall, 0.06-0.10 inch in its widest diameter, subhemispherical above, rather flatter below, with a nipple-like opening in the middle. Walls of the gall rather stout, fleshy and not woody. The external color is greenish-yellow above and pale green below, with the open central nipple whitish. There are frequently as many as 100 of these galls on a single leaflet. Inside may often be found as many as three or four mother bark-lice, similarly shaped and of the same yellow color as those of the *vitifolia* gall, but on the average rather smaller and accompanied, in the same manner, by eggs or very

young larvæ, or both. As with the mother bark-lice of the galls *vitifoliæ* Fitch, *carya-cenæ* Fitch and *carya-fallax* Walsh MS., the antennæ of this mother bark-louse are three-jointed, joints 1 and 2 short and subequal, and joint 3 longer than 1 and 2 put together. The young larvæ are about 0.01 inch long and of the usual shape. Almost as soon as hatched—as is also the case with the larvæ of all the allied galls—these larvæ stray away to found new galls. The galls themselves are very abundant about July 24th, but by the 12th of August they were almost all empty and gaping open below.”

Dr. Shimer, referring to the same species (Proc. of the Acad. of Nat. Sci. of Phil., Vol. 19, 1867, p. 3), confounds it with his *Dak. globosum*, which forms a similar though much larger gall on the same leaves and produces a winged generation. Speaking of the young of the smaller galls he says “the young larva usually leaves the gall as soon as hatched and proceeds, as does the ‘grape-leaf louse’ (*D. ? vitifoliæ*), to construct a new gall.”

The following notes, made in the West some years ago, will amplify the somewhat brief description of the gall by Walsh:

Description of Gall.—Transverse diameter 0.3–2^{mm}, or slightly larger. Vertical diameter 0.2–0.5^{mm}. Hemispherical and more prominent above than beneath and frequently depressed at the centre, the depression often running out to one side. More or less projecting beneath, with a tendency to become somewhat conical, terminating in a short nipple, with a round or slightly oval orifice, surrounded by 4–10 or more rather stout and profusely pubescent recurved bracts, completely closed when young. Upper surface smooth, yellowish-green to brownish-yellow. Rather tough and leathery and slightly semi-transparent at the centre if held toward the light.

This gall is usually extremely abundant on infected trees, often to such an extent that every leaf is completely covered. I have counted on some of the smaller leaflets over 300 of these galls, many of which, to the number of 2–5 or more, were confluent.

This appears to be an exclusive western species and has been found at Kirkwood and elsewhere in the Mississippi Valley, upon *Hicoria glabra*, maturing during the latter half of July and early August.

PHYLLOXERA CARYÆ-FALLAX Riley.

Pl. IX., figs. 52-53; Pl. XI., figs. 71-74.

Phylloxera caryae-fallax Riley. Seventh Rep. Nox. and Ben.
Ins. of Mo., p. 118.

Phylloxera caryae-fallax Thomas. Eighth Rep. Nox. and Ben.
Ins. of Ills., p. 164.

Considerable doubt has existed until lately in my mind as to the identity of the species briefly referred to under this name by Walsh in his "First Ann. Rep. of the Nox. Ins. of Ills.," p. 23, and that described by Riley under the same name in the "Seventh Ann. Rep. on the Nox. and Ben. Insects of Mo.," p. 118. Walsh states that he never found a winged insect either in this gall or in those of *c.-semen* and *c.-foliæ*, though he has opened and examined hundreds of them. My observations regarding this peculiar gall, extending as far back as 1872, run counter to those of Walsh, for I have found this particular gall swarming with the winged female.

To account for this apparent discrepancy in independent observations, it may be stated that my own observations were made from early May until June, and that these made by Mr. Walsh were from the 17th until the end of June, or at a time when the winged form had already forsaken the galls. What, then, were the numerous larvæ (?) with which he found the galls swarming, and what was their office? They could not well form new galls, as the season for that purpose was already too far advanced!

The explanation will doubtless be found in the following facts:

If the galls be opened early in May, or before the nipple has opened, they will be found filled with winged insects, pupæ, numerous eggs, and what appear to be larvæ. These supposed larvæ, however, upon careful examination, are not larvæ hatched from eggs deposited by the stem-mother, but the true sexual individuals, both males and females, produced from eggs deposited freely by the winged females. In this species, therefore, the sexed individuals are (in part at least) produced within the original gall, though winged females subsequently perform the true function of migrants and leave the galls to carry their sexed young elsewhere.

The gall of this species is one of the most common and numerous on the leaves of *Hicoria* (*Carya*) *alba*, and probably some other species of the genus in the states of Missouri and Illinois, extending at least as far south as Tennessee and probably throughout most of the states bordering the Mississippi. It seems to be exclusively a western species, and is at times so extremely abundant as to cover completely every leaf upon a tree, the leaves becoming much dwarfed and distorted. On some small leaflets, about 2 inches long by $\frac{3}{4}$ inch wide, more than 300 of these galls were counted.

The fully grown galls vary in height and diameter at base from 1–5 ^{mm}. Those more densely crowded are narrower at base and higher in proportion. They are conical or tooth-like above and frequently lean over to one side. The under side is more or less prominently convex and more or less prolonged at the centre, with the nipple often, also, inclining to one side. The orifice is either round or oval, closely fringed with pale hairs, and tightly drawn together till maturity. The walls are rather tough and leathery. The color of the galls when younger is greenish-yellow to reddish, becoming gradually brown or black, and brittle after the insects have left.

STEM-MOTHER.—Length about 0.6^{mm}. Body almost globular. Color, orange; legs and antennæ dusky. Eyes, dark purple. Surface of body quite densely covered with rather coarse, somewhat conical granules, though less dense than in the stem-mother of *Ph. deplanata*, the granules interspersed with a few stiff hairs, most numerous about the anal segment, and some of them capitate. Antennæ rather stout, the third joint about as long as the tibiæ and somewhat clavate, with about 18–20 rather coarse and apparently scaly annulations, and provided at tip with two short hairs. Legs rather long and stout.

MIGRATORY FEMALE.—Length of body 0.6–0.8^{mm}. Expanse of wings 2.3–2.8^{mm}. Color, orange yellow. Head and thorax blackish, the head often paler. Eyes purplish; the two inner ocelli red, the frontal one colorless, all bordered with black at inner side. Antennæ and legs faintly dusky. Wings pale brownish; stigma and veins darker; the veins shaded with dusky. Venation normal, stigmal vein and cubital branch almost parallel.

Head and prothorax rugose, the latter but finely so. Surface of body covered quite densely with minute, somewhat conical, granules. Antennæ rather slender and quite peculiar; apparently 4-jointed. Joint 1 about as long as wide or but slightly longer, truncate at tip and faintly scaly; joint 2 more slender, distinctly longer than wide, a trifle thinnest at base, rounded at apex and quite coarsely scaly; joint 3 appears to be composed of two joints, the basal section abruptly truncated just above the lower sensorium, and tapering gradually to the base, coarsely scaly and divided by 6-8 quite distinct annulations; the terminal section is about two-thirds the length of the whole joint, its sensorial membrane much elongated and about one-half the length of the entire joint; its diameter quite uniform, though the part below the sensorium is somewhat thinner and divided by five or more coarse and somewhat scaly annulations; the remainder of the joint is coarsely scaly, with two or three short annulations at the apex, resembling minute joints.

This antennal structure comes quite near to that of *Ph. picta*, the third joint of the antennae of which is more or less distinctly divided into two sections.

SEXUAL INDIVIDUALS, ♂ ♀.—Length about 0.4^{mm}, the female being somewhat the larger. Color orange. Eyes blackish. Antennæ and legs pale dusky. Surface of body quite smooth, apparently without granulations, and provided with four rows of rather stout, capitate hairs, which are somewhat longer and stouter in the females. Antennæ stout, the third joint longer than the tibiæ, clavate, with 10-12 more or less well-defined annulations. From the apical fourth of the third joint rises a long, stout, capitate bristle; two short, fine hairs at the tip, and another a little lower down on inner side. Legs very stout, more so than usual. Rostrum rudimentary, not fitted for sucking.

GROUP II.

Galls more or less fleshy, not transparent, usually more protuberant beneath than above; conical, globular, or pedunculate; opening always beneath.

13. Large; convex on both sides, more prominent beneath; circumference above button-like, with a more or less sharply defined edge; either above or sunken beneath the surface of the leaf; nipple short, surrounded by short bracts. Opening round... *Ph. rimosalis* n. sp.

14. Subglobose; about equally prominent above and beneath; without a nipple; opening in a transverse slit *Ph. c.-scissa* Riley.
15. Subglobose, somewhat more prominent above than beneath; without a nipple; the orifice an elongate slit *Ph. c.-globuli* Walsh.
16. Subglobose; about equally prominent on both sides; conical beneath, ending in a short nipple, splitting into several stout bracts *Ph. conica* Shimer.
17. Flat above, either flush with, or sunken below the surface. Globular or pyriform beneath and more or less constricted at base; with or without a distinct nipple, which, when present, splits into several bracts..... *Ph. c.-avellana* Riley
18. Size medium; quite flat above, usually with a more or less distinct median depression; prominent and conical beneath; not constricted at base. Nipple distinct, surrounded by short bracts.
Ph. symmetrica n. sp.
19. Large, more or less irregular; convex above; more prominent and conical beneath, splitting at maturity into several very long bracts.
Ph. notabilis n. sp.
20. Large; globular; projecting about equally on both sides; the nipple short, with four to five short, stout, pubescent bracts surrounding the orifice, curving outwards when old..... *Ph. c.-globosa* Shimer.
21. Large; pedunculate and more or less elongated; suspended from the under surface by a slender petiole, quite sticky when fresh; split at the apex into several long filaments *Ph. c.-gummosa* Riley.

PHYLLOXERA RIMOSALIS Pergande, n. sp.

Pl. IV., fig. 24; Pl. IX., fig. 54.

A very large and conspicuous gall, growing always upon the leaves of *Hicoria tomentosa*, bearing a great resemblance to the gall of *Ph. c.-scissa*, from which it differs in the round, not elongated, orifice and in some other characters.

It is not uncommon along the Potomac near Washington and affects more generally the terminal leaves of the more succulent young shoots. It matures somewhat later than most of the other galls, the first winged females occurring the latter part of May. It grows generally singly, though occasionally 2-4 may occur on the same leaf, in which case they tend to become more or less confluent, so as to form a large, flat mass; each retaining, however, its cell independently. It forms upon any part of the leaf, often very close to the edge, and may extend across two or

even three of the transverse veins, (when the upper surface becomes somewhat uneven) but never, as far as observed, across the midrib. The horizontal diameter ranges between 3-11^{mm.} (those growing singly being usually much the largest) and between 1.6-3.4^{mm.} in height. The form is quite flat or but slightly convex above, with the circumference usually sharply defined and sunken below the plane of the leaf, which forms around it a somewhat elevated and quite sharp edge or rim. The disk may be raised button-like above the plane of the leaf. Sometimes the upper surface is slightly uneven or concave; or there may be a slightly convex, central elevation, with a dimpled depression on one side of it. Beneath it is much more prominent and convex, resembling somewhat that of *c.-septum*, except that its nipple is extremely short and conical, with the orifice round and completely closed in the younger ones, with indications that it will split when mature into 5-8 short bracts, which are closely covered at the tip and inner side with minute, white, silken hairs. The surface above is perfectly smooth, whilst the under side is sparsely beset with short, pale yellowish, radiating hairs and yellow papillæ which characterize the under side of the leaves.

It is seen to be slightly transparent, if held between the light, especially around its margin. Its walls are rather thick and hard, especially at the base. The color above and beneath is of a somewhat paler green than the surrounding surface of the leaf, occasionally faintly tinted with red at the centre and polished above.

Each gall contains, by the middle of May, besides the single stem-mother, large numbers of eggs, larvæ and young pupæ, covering closely its inner walls, each with the end of the body directed toward the centre, as if they were standing on their heads. Some individuals acquire wings by about the 20th, while the majority do not reach this condition till the end of the month or the first week in June.

STEM-MOTHER.—Length when fully developed about 1^{mm.}; greatest diameter about 0.5^{mm.}. Elongate-pyriform, the older, or those which are nearly empty of eggs, are more or less broadly ovoid, 0.6-0.8^{mm.} in length and 0.4-0.7^{mm.} in diameter. Color

pale yellow in the younger and faintly brownish-yellow in the older. Eyes dark purple. Antennæ and legs dusky or blackish. There are usually two, more or less distinct (in some quite large, in others entirely lacking) black, double impressions on the head, somewhat in front of the eyes; several small black spots on the prothorax (often indistinct or wanting), two of which are near the anterior margin, and a group of three subdorsal spots each side, posteriorly; there is also a subdorsal spot in each of the first three abdominal sutures. Surface of body almost smooth, the sculpturing being almost invisible. Front of head more or less concave, with a short hair each side of the concavity. Antennæ short, the first joint stoutest and almost globular, the second longer than wide and of almost uniform diameter; the third slender, slightly stoutest towards the end and quite coarsely annulate.

EGGS.—White, or with a faintly yellow tinge, highly polished and with a distinct hexagonal sculpture.

LARVÆ and younger PUPÆ white or with but the faintest yellow tinge; eyes red; antennæ and legs very faintly dusky. The whole body densely covered with very minute points. The younger pupæ are marked with dusky spots very much as in the stem-mother. Wing-sheaths faintly dusky.

PUPA, mature.—Color orange, the mesothorax, wing-pads and two or three terminal abdominal segments whitish, the mesothorax often with a somewhat greenish tinge. Eyes and spots indicating the ocelli, red. Antennæ and legs pale dusky. There are two small dusky spots behind the ocelli, and a subdorsal curved row of six blackish punctures on each side of the prothorax, the posterior three of which are arranged in a triangular group, similar to those of the stem-mother. Antennæ stout and with but faint indication of sculpture. Entire surface of body densely and quite coarsely granulate.

MIGRATORY FEMALE.—Length of body about 1^{mm}. Expanse of wings 2.3–2.5^{mm}. Color pale orange, palest toward the end of the body. Front of head, as far as the posterior edge of the eyes, the two middle lobes of the mesothorax and the sternal plate, blackish, all other parts dusky or brownish, with a yellowish tinge. Posterior half of head pale orange. Eyes brown;

ocelli yellowish, broadly bordered at inner side with dark brown. Two small dusky spots behind ocelli. Anterior angles of prothorax pale dusky, and two small, dusky, transversely linear spots, usually more or less indistinct, on the middle of the prothorax. Wings faintly dusky, the stigma, subcosta and discoidal vein darkest, the two branches very faint, though normal in their course. Surface of wings quite profusely granulate or scaly. Antennæ dusky, short, scarcely as long as the head is broad, the two basal joints almost equal in length, the first slightly longest and stoutest, narrowest at base, truncate at tip; the second almost as long as wide, rounded and stoutest at tip; both joints quite distinctly scaly; joint three is rather robust, diminishing but slightly and gently toward the base, connecting with the second joint by a very short though well separated petiole. There is no basal constriction and, apparently, only the upper sensorium present, which is rather stout and somewhat oval; surface quite coarsely scaly with the lower third sharply annulate; from 3-4 distinct, short bristles surround the apex, the two terminal ones stoutest.

PHYLLOXERA CARYÆ-SCISSA Riley.

Pl. IV., fig. 25; Pl. IX., figs. 55, 56.

Phylloxera caryæ-scissa Riley. Am. Ent. Vol. III., n. Ser. Vol. I., p. 230.

This gall, as already indicated, bears a close resemblance to that of *hemispherica* but it will be unsafe to consider them identical until further careful study is made of the latter species.

The first galls of *caryæ-scissa* were received in 1880 from Mr. W. H. Ashmead, of Jacksonville, Fla., found growing upon *Hicoria alba*. Since then the same species has been occasionally observed in the vicinity of Washington, always growing upon the leaves of *Hicoria tomentosa*. It is a rather rare species, and occurs for the most part singly.

In general appearance it closely resembles that of *Ph. rimosalis*, for which it might readily be mistaken, but the upper surface of *c.-scissa* is never flattened, as in *rimosalis*, while the orifice is never round or nipple-like, but always a tranverse slit. All the different forms of insects, from the stem-mother to the winged

female of *c.-scissa*, are also larger and darker, with the antennæ much longer and more slender, particularly in the winged form.

The transverse diameter of this gall ranges from 8–14^{mm} and the height from 2–5^{mm} or more. It is about equally convex on both sides, though sometimes more prominent either above or beneath, and often with a slight, central, nipple-like projection above. The surface on both sides is more or less distinctly covered with short, fine, yellowish hairs when upon *Hicoria tomentosa*; while upon *H. alba* it is smooth above and but slightly hairy beneath. The gall is always situated between two of the transverse veins, with the slit either parallel with them or slightly oblique. When young, this slit is slightly closed and not easily seen, but forms regular, shallow lips, densely pubescent, when older. Color above and beneath pale greenish or dirty yellowish-green.

The winged female may be found from the middle of May to the middle of June.

STEM-MOTHER.—Length 1–2^{mm}; diameter across the thorax 0.8^{mm}. Shape broadly ovoid. Color pale yellow; antennæ and legs faintly dusky; eyes purplish-brown. There are two deep black punctures on the front of the head and two smaller and somewhat oval spots at its posterior edge. A somewhat angulated, dusky, subdorsal spot each side on the prothorax; a larger, transverse spot each side in the first suture, and a smaller one each side in the two following thoracic sutures; also, a lateral row of three spots: the first is placed in the last thoracic suture and the others in the sutures of the first two abdominal segments. Granulation of body extremely minute and sparse. Antennæ and legs slender. First joint of antennæ stoutest; joint two considerably longer than wide and of almost uniform diameter, rounded at tip; joint three very slender, of almost uniform diameter, slightly stoutest at the apical one-third and quite coarsely but rather sparsely annulate.

Eggs white, regularly ovoid, highly polished and apparently without sculpturing.

LARVA and youngest pupæ white or faintly yellowish, the eyes red; the legs and antennæ slender; the whole body densely covered with distinct granules.

PUPA, mature. —Orange, the wing-pads and two or three last abdominal segments whitish, wing-pads becoming dusky externally with age. Antennæ and legs shaded. Eyes small, brown. Ocelli barely indicated by obscure brownish spots, between which are noticed two small, pale brownish piliferous spots. A subdorsal spot each side of prothorax. Entire surface of body densely granulated. Antennæ very slender, the third joint about three times as long as the two basal joints combined.

MIGRATORY FEMALE.—Length of body 1-1.2^{mm}. Expanse of wings 3.4^{mm}. Color orange. Head, mesothorax, scutellum and sternal plate blackish. Eyes dark brown or purple, almost black. Ocelli clear, colorless, broadly bordered at inner side with brown. Wings pale fuscous, the costal cell and stigma brownish; the stigma either not separated or scarcely separated from the costal cell. Venation blackish, normal, bordered with a dusky shade, especially the cubital vein. Surface densely covered with minute scale-like points. Anterior angles of prothorax broadly dusky; two small, more or less confluent, discal spots, a transverse spot at anterior margin and an elongated subdorsal spot each side, usually remaining quite pale. Surface of body quite densely granulated, the granulation less prominent than in the pupæ. Antennæ long and slender: joint 1 longer than wide, stoutest toward the base, curved outward toward apex; joint 2 shorter than one, a little longer than wide, narrowest at base, the apex nearly straight; joint 3 almost four times as long as the two basal joints combined: indented above its basal one-third, beyond which it becomes quite slender; both the anterior and posterior sensoria very indistinctly defined, the upper rather more than one-half the length of the upper section above the indentation; the whole surface quite densely scaly.

PHYLLOXERA CARYÆ-GLOBULI Walsh.

Phylloxera caryæ-globuli Walsh. Proc. Ent. Soc. Phila., Vol. I., p. 309.

Phylloxera caryæ-globuli Walsh. Proc. Ent. Soc. Phila., Vol. VI., p. 275.

Dactylospæra hemisphericum Shimer. Trans. Am. Ent. Soc., II., p. 386.

Phylloxera caryæ-globuli Riley. Seventh Ann. Rep. Nox. and Ben. Ins. of Mo., p. 117.

Phylloxera caryæ-globuli Thomas. Eighth Ann. Rep. Nox. and Ben. Ins. of Ill., p. 164.

The galls of this species, as far as can be learned from the descriptions of Walsh and Shimer agree quite well with those of *c.-scissa* and I simply repeat here the original descriptions. That by Walsh is rather insufficient, somewhat scattered and mixed with other matter, from which it has been sifted.

Phylloxera caryæ-globuli Walsh. Proc. Ent. Soc., I., p. 309, and VI., p. 275.

"Galls spherical, generally located between the veins that branch from the midrib of the leaflets of the Shag-bark Hickory, and when ripe opens below by a simple, longitudinal slit. Never exceeding one-half or one-third the extreme diameter of *caryæ-caulis*.

"MIGRATORY FEMALE. —Length to tip of wings .07-.08 inch. Three specimens. The antennæ are scarcely longer than the head and I am unable to distinguish the joints. The stigma is about three times as long as wide, straight posteriorly, slightly hunched anteriorly and acute at both ends. Abdomen blackish [doubtless from dead and dry specimens, as no phylloxeræ have the abdomen black in life]; the whole costa pale brown, the stigma with a yellow tinge; the third or stigmal vein is not abortive at its origin and the second or middle vein not parallel with the third, but each of the two is slightly convex toward the other."

Dactylospæra hemisphericum Shimer. Trans. Am. Ent. Soc., II., p. 386.

Galls on the Shell-bark Hickory (C. alba).

"GALL NO. 1.—This is a large subhemispherical gall, situated in the parenchyma of the leaf, generally projecting above the plane of the latter. Structure somewhat thick, tough and dense, the average thickness of the walls being about .05 inch. Color pale whitish-green, much paler than the leaf, the upper surface frequently tinged with red and often quite purple-red. Size: diameter in the plain of the leaf, one-fourth to one-half inch; vertical diameter one-half.

"These galls open beneath with a slit, the length of which is about one-third of the diameter of the gall: its direction is usually in, or somewhat oblique to, that of the veins of the leaf, and when oblique, more nearly parallel with the longitudinal axis of the leaf. The lips of these slits are pinched so tightly together as to project out, and their margins are either smooth or slightly hairy. Sometimes a leaf contains but a single gall, others two or more. The galls may be scattered irregularly on the leaf, or placed in one or two rows along and near the midrib, and one or two dozen may be found in a single row, placed so closely together as to be contiguous.

"Upon opening one of these galls, I found the mother insect and her eggs, the latter in great abundance, one hundred or more studded all over the concave surface: but very few eggs had then (June 7th) hatched. But on opening one of the largest galls, which seemed to be in a much more advanced state, I found the mother insect in the midst of a very numerous brood of newly-hatched larvæ, and also many eggs still unhatched: the new-born larvæ were pale greenish-white, while those more advanced were of a deeper color and of all shades approaching to orange: many were already in the pupa state, having short wing-cases. The mother insect moved in a stately manner among her numerous offspring, apparently proud of her queenly position.

"On June 18th the galls were in prime condition for examining the inhabitants: many were opening at the slit beneath and the winged imagos escaping in great numbers. The following is a description of the species:

Dactylosphara hemisphericum, n. sp.? Walsh., Proc. Ent. Soc., I., 309.

"Winged Imago.—Light orange yellow, head, antennæ, legs, and a band around middle of thorax blackish: abdomen pointed: wings delicate, hyaline: antennæ viewed with a single lens apparently 3-jointed. Length of body .04; to tip of wing .06 inch.

"Microscopic view.—Antennæ 5-jointed, the first two, as usual, short and thick: third longer: fourth slender, shorter than third: fifth clavate, longer than third and fourth and about as thick as the third: these joints do not appear so evident in all specimens, as sometimes only four are discernable, and sometimes the microscope separates the antennæ on one side into four joints, and that on the other into five. Promusculus slightly hairy, 3-jointed, the middle joint shortest and thickest, and the third

longest. Legs slightly hairy: femora very thick above, slender in the middle, being not half the upper diameter, then swelling out and clavate toward the lower end; feet with one joint, two claws and two digituli, which have clavate ends.

"Mother Insect.—Pale greenish-yellow, orange-yellow about the head; antennæ, proboscis and legs black; abdomen pointed, very versatile.

"*Microscopic view*.—A few very short, fine, black hairs scattered over the body; three spiracles are seen along each side; surrounding the femur there is an inverted conical or bell-shaped cup, bordered with black, within which the limb has room to work freely, and outwardly a frænum or skin attaches the side of this cup to the body, its lower margin black and about as large as the diameter of the cup. Proboscis projecting downwards between the fore legs. Eyes black. Tarsi with one joint, two claws, two long globe-ended digituli, and several hair-like spines. Antennæ 3-jointed, first two joints short and thick, subglobular, the last long and clavate.

"Pupa.—Pale orange, wing-pads lighter; eyes brown; ocelli red; feet plainly showing two digituli."

Of the winged imago thousands were observed, each cell containing from thirty to forty specimens. On June 18th I found no eggs, only a few larvæ and many pupæ.

I am rather suspicious that this *may* be the *Phylloxera caryæ-globuli* of Walsh; but he says (*ibid.*) that the gall of his species is "spherical" and also that the size of the insect is ".07 to .08 inch in length" and that the abdomen is blackish. But unless described from living specimens, the color is of no value, as they all turn black after death.

PHYLLOXERA CONICA Shimer.

Pl. V., figs. 26-29; Pl. XI., figs. 75-78.

Dactylosphæra conicum Shimer. Trans. Ann. Ent. Soc., 2, p. 390.

Phylloxera c.-conica Riley. Seventh Ann. Rep. Nox. and Ben. Ins. of Mo., p. 118.

Phylloxera c.-conica Thomas. Eighth Rep. Nox. and Ben. Ins. of Ill., p. 1.

It is rather strange that Shimer failed to mention the color of this gall, notwithstanding it is one of the handsomest of this group. There can scarcely be any doubt, however, that the gall

here considered is identical with that described by him under the above name.

The first notes upon the species were made in 1872 when it was found in Missouri on the leaves of the Bitter-nut Hickory, (*Hicoria amara*). This is one of the most widespread and common of the Hickory galls in the Mississippi Valley, and was frequently sent by correspondents for identification. The galls begin to form the latter part of May and are then almost globular, though somewhat more prominent above than beneath, with a scarcely noticeable nipple on the under side, densely covered with yellowish pubescence. Their color is a deep purplish-brown, contrasting prettily with the light green color of the young leaves; their surface above and beneath is more or less roughened or granulated, and the appearance reminding one strongly of the galls of *Cecidomya q.-pilula* of the oak.

By the first week in June the galls are fully grown, but only contain the stem-mother, her eggs and larvæ. By the middle of the month the winged female prevails, with but few pupæ and still fewer larvæ, while in many cases the galls have opened and migration has actively begun.

The transverse diameter of the matured gall varies from 3-7^{mm.} and their vertical diameter from 2-5^{mm.}. Many of them are almost globular, and, as a rule, more prominent above than beneath. Occasionally, however, they are more prominent beneath. In the majority, especially the larger galls, the under side is considerably sunken beneath the surface of the leaf and much less conical and usually much paler than when younger. The color above is a dull, dark purplish brown, sometimes, however, with only a brownish shade, or entirely of a dull greenish-yellow. The surface above, and sometimes slightly beneath, is densely and quite coarsely rugose and more or less distinctly pubescent, especially beneath, and covered with a more or less noticeable sticky or viscid excretion. The orifice is more densely pubescent than the rest of the gall, and splits, when mature, into 4-8 short bracts. The walls of the galls are rather stout, leathery and flexible. At full growth the inside is almost pure white, but by the time the insects are ready to leave, the color is brown all through. Generally these galls grow singly, though there

are often as many as ten, of which several may be confluent, on the same leaf.

STEM-MOTHER.—The fully grown stem-mother measures between 0.8–1^{mm} in length, the younger broadly pyriform, the older perfectly globular. Color pale yellow with a slight dusky tinge. Antennæ and legs blackish. Eyes small, black, scarcely seen from above. Surface of body closely covered with minute points. No piliferous warts noticeable. Antennæ rather long and stout; joint 1 about as long as broad and of nearly uniform diameter; joint 2 longer than broad; joint 3 about thrice as long as the two basal joints together, of nearly uniform diameter, or slightly thinnest at about the middle and divided by about eighteen rather coarse, more or less distinct annulations. The thumb is minute though quite distinct.

EGGS.—Perfectly white, highly polished and with distinct, large, hexagonal sculpturing.

LARVA.—White, the larger ones faintly yellowish, the eyes red. In the larger individuals may be noticed a group of prominent granules, just at the anterior angles of the mesothorax. Surface of body very minutely granulate. There are four small round warts along the front edge of the head, each bearing a fine hair, and one just opposite the eyes. Similar, though rather sparsely distributed warts, are noticed all over the body, but on account of their pale color they are not easily seen. The pupæ are of the same pale color as the larger larvæ.

MIGRATORY FEMALE.—Rather slender. Length of body 0.8–1.2^{mm}. Expanse of wings 2.2–2.6^{mm}. Color pale yellow, the prothorax and posterior half of the head darker. Anterior half of head, mesothorax, scutellum and sternal plate brownish or blackish. Eyes dark brown. Ocelli yellowish, bordered narrowly with black at inner side. Antennæ and legs pale dusky. Insertion of antennæ white. A small dusky subdorsal spot each side of the prothorax. Wings large, pale fuscous, the veins and stigma darker, the surface quite densely scaly. Surface of body densely but minutely granulated. Antennæ about as long as the head is wide posteriorly: joint 1 about as long as wide or slightly longer and slightly narrowest at base; joint 2 also about as long as wide, almost globular and with distinct, sharp, scaly annula-

tions; terminal half of joint 3 of nearly uniform diameter, tapering slightly from the upper sensorium to the base; upper sensorial membrane about one-half the length of the joint; the lower one wanting. The whole surface is densely scaly and sharply annulated, especially the lower half.

PHYLLOXERA CARYÆ-AVELLANA Riley.

Pl. V., figs. 30, 31; Pl. VI., figs. 32-36; Pl. XI., figs. 79-81.

Phylloxera caryæ-avellana Riley. Am. Ent., Vol. III., n. ser., Vol. I., p. 230.

Not uncommon on the leaves of *Hicoria tomentosa* along the Potomac near Washington.

Judging from the appearance of the galls, as regards size, shape and color, one might be led to conclude that we had to deal with two or more distinct species. A careful study and comparison, however, of the architects in their different stages, shows but one species. The more typical, larger and more brilliantly colored galls are the product of those stem-mothers which first settled, at a time when the development of the young leaves was most rapid and the circulation of the sap most vigorous.

By the 20th of May many of the galls already contain pupæ or even winged females, while others contain only eggs and larvæ. By the middle of June most of the galls are already empty and by the end of the month have become dry and shrivelled.

The transverse diameter varies from 5-10^{mm}. and the height is about the same. Flat or but slightly convex above and either flush with or somewhat sunken beneath the surface of the leaf; sub-conical or more or less globular beneath, constricted at base and resembling somewhat in shape a diminutive filbert. The surface beneath is quite densely pubescent and with similar minute yellow papillæ as those which cover the under side of the leaves, and causing a certain stickiness. The orifice, at the top of the gall, is, before maturity, closely drawn together and densely covered on the inside with white wooly hairs, opening at maturity into several short and stout bracts. Walls very thick and succulent. The color above is either greenish, yellow-green or of a more or less intense, beautiful crimson or pink; and beneath pale greenish, or even almost white.

STEM-MOTHER.—The stem-mother varies from 0.8–1.3^{mm}. in length, and is about half as wide. Shape broadly-ovoid, pointed posteriorly, almost globular in the older specimens. Color pale yellow, with a faint dusky tinge, slightly orange or dull greenish-yellow in the older specimens. Antennæ and legs black. Eyes dark red or black or purplish-black and rather small, with two deep, blackish, median punctures a little in front of them. On the head an oblique, blackish depression each side anteriorly, a larger subdorsal depression each side on the prothorax, and a blackish, subdorsal spot in the three following sutures, all of which spots, with the exception of those on the head, become more or less completely obliterated in older specimens. There are, in addition, four rather prominent warts along the front edge of the head, one each side behind the antennæ, one each side at inner edge of eyes, one each side of the two punctures and two at the posterior margin. Two similar warts each side of the thoracic and one each side of the abdominal segments. Beside these warts there are two transverse rows of four warts across each of the thoracic and one row of four across the abdominal segments, each bearing a short, stiff hair. Surface of body densely covered with minute sharp points. Front of head more or less concave. Antennæ rather short, but little more than one-half the length of the posterior margin of the head: joint 1 very stout and but little longer than wide; joint 2 more slender, longer than wide, stoutest and almost straight at apex; joint 3 slender, of nearly uniform diameter, somewhat curved and quite coarsely annulated, its tip truncate, surmounted by a stout hair and two smaller ones a little below the tip; thumb small and insignificant. Legs and tarsi rather stout, the terminal pair of the tarsal bristles (or *digituli*) with the knob much larger and more conspicuous than usual.

EGG and LARVA white or faintly yellowish; the sculpturing of the eggs extremely delicate and sub-obsolete. Surface of the body of the larva densely covered with minute granulations; eyes red, antennæ and legs whitish.

PUPÆ pale orange, the younger specimens whitish or pale yellow, with the external edge of the wing-pads often blackish.

Eyes red, ocellar spots reddish. Antennæ and legs dusky. Surface of the whole body densely granulated.

MIGRATORY FEMALE.—Length of body 0.9–1.2^{mm}. Expanse of wings 2.2–2.8^{mm}. Color orange, the prothorax somewhat the darkest. Head, mesothorax, scutellum and sternal plate, black. Antennæ and legs dusky; eyes brown or dark purple. The prothorax is often faintly dusky and is often marked medio-dorsally with three more or less distinct, minute spots, of which the two smaller, anterior ones, are more or less oval, and the larger posterior one linear. Antennæ about as long as the tibiæ: joints 1 and 2 about equal in length and but faintly annulated; joint 3 much the largest and almost three times the length of the other two combined, almost uniform in diameter throughout its whole length, quite straight, with a short pedicel at base and terminating in a distinct nipple which shows at least two well-marked annulations and is provided with three extremely fine hairs; the whole joint is but faintly annulate, the annulations more numerous and more distinct at its basal fourth, the sensoria sub-obsolete, particularly the basal one, the terminal one very slender and about one-half as long as the joint. Wings ample, faintly dusky, the veins and stigma darker, the subcosta yellowish at base; of the veins the discoidal vein is darkest, and all are bordered with a faint dusky shade. The discoidal vein arises somewhat nearer to the stigma than to the base of the wing and branches near its middle; the stigmal vein is but slightly curved and starts from about the middle of the stigma. Legs rather short.

PHYLLOXERA SYMMETRICA n. sp., Pergande.

This species, as far as its gall is concerned, appears to be closely related to, if not identical with, *Ph. conifera* Shimer (Trans. Am. Ent. Soc., Vol. II., 1868, p. 397), but as his description, both of the gall and its architect, is rather vague, brief and general in characterization, so much so as to apply equally as well to many others, it is deemed more expedient to describe it as new.

This gall has been noticed on young trees of *Hicoria* (*Carya*) *tomentosa* and some other species, in the neighborhood of Wash-

ington, for quite a number of years and appears to be slowly but gradually increasing.

Judging from the appearance of the galls alone, one is tempted to divide them into two or perhaps three distinct species, with regard to shape, size and color. A careful study, however, and comparison of the migratory forms of their architects, have conclusively convinced me that the different forms of these galls are nothing else but varieties of one species, depending, as it appears, on the earlier or later settling of the young lice, and the therewith connected more or less advanced stage of development of the young leaves. There can be no doubt that the larger and more brilliantly colored galls are the product of such of the young lice of this species which hatched in advance of the bulk of the same brood, just at the time when the development of the leaves was most rapid and the circulation of the sap most vigorous. To enable the future student, therefore, to recognize these different forms more readily, it is deemed expedient to figure each form of gall and to give each of them a variety name. All these forms are usually, at least in this locality, met with at about the same time and upon the same trees, though the two largest or more brilliantly colored galls are much scarcer than those of the typical form. As a rule, there is generally but a single gall on a leaflet, though occasionally two, or even as many as five or six, and in one instance even as many as twelve were observed upon a single leaflet, all crowded together near the base of the leaf, and more or less confluent. If there be more than one on a leaf, it will be observed that generally most of them are dwarfed, whilst but one or two have attained their full size.

At what date the young stem-mother settles down has not been ascertained, though it must be at the time when the young leaves begin to unfold, at about the middle or latter part of April, for it was observed that by the 20th of May many contained already pupæ, and a few even some winged insects, whilst others contained only eggs and larvæ. By the 15th or 20th of June most of the galls are empty and by the end of the month all inmates have left and the galls become dry and shrivelled.

PHYLLOXERA SYMMETRICA n. sp., Pergande.

TYPICAL FORM.

This gall forms always on the under side of the leaf; it is quite flat on the upper side, or slightly convex, occasionally somewhat depressed at the middle, circular, with its margin generally more or less deeply sunken below the plane of the leaf and generally concolorous with the upper side, or of a somewhat darker shade. On the under side, however, it is quite prominent and regularly conical in shape, with an opening at the tip, which, however, is tightly closed till the time arrives for the migrants to leave. At this time the apex commences to split into 4-8, more or less slender, backward-curved bracts or filaments, surrounding a more or less circular opening. The color of the lower side of the galls is either that of the leaf or somewhat paler, though rather darkest towards the apex, and their surface covered rather sparsely with the peculiar hairs and pellets of resin so characteristic of the under side of the leaves, becoming more dense towards the apex. The walls of this gall are rather stout and of a dense and firm texture, increasing in thickness toward the base. The transverse diameter above ranges between 2-5^{mm.} and the vertical diameter from 3-4^{mm.} After the insects have left, the galls gradually dry up, become brown, lose their shape and disappear at last almost completely.

In this connection it will be interesting to record here what appears to be a second crop of galls of probably the same species, though it is quite possible that later observations may prove this to be distinct.

On the 29th of July, 1883, while examining a solitary young hickory tree near the fair-ground, in the District of Columbia, standing at a distance of between 20-50 feet from the nearest trees of its own kind, it was observed that considerable numbers of young galls had formed on the uppermost and youngest leaves, which, to all appearance, could scarcely be older than, perhaps, two or at most three weeks. A further examination of the older leaves proved that they had been infested quite profusely by galls of the species under consideration, all of which were empty and more or less dried up, though a few were still on the upper

side: no galls of any other species could be detected on any of the leaves. Notwithstanding this fact, it is still possible that these new galls were the product of some other species, the winged form of which may have migrated there from some distance. These newly formed galls were smaller and also quite different in appearance. Their upper surface is also scarcely elevated above the plane of the leaf, with the centre quite distinctly depressed. This depression is reddish or pink and is generally encircled by a pale yellowish-green ring, the under side is more prominent, though by no means conical, and somewhat paler than above. All contained, besides the females, numerous eggs and also a few larvæ. The female is yellow with the eyes black, the larva pale yellow with reddish eyes; the eggs are colorless, the more mature ones faintly yellowish.

Var. A. *PHYLLOXERA VASCULOSA* Pergande.

This variety is more striking in appearance and much larger than the more common or typical form. It grows also on the under side of the leaves, but is rather scarce, there being not more than from one to perhaps twelve or a few more upon a tree. Its upper surface is very much like that of the typical form, though it is often considerably sunken below the plane of the leaf and is of very much the same color. The galls proper, on the under side, are very much of the shape of a vase or urn. They are more or less constricted at base, the sides rounded and of a pear- or more or less globular form. The opening at tip, which is closed while the galls are immature, opens at maturity into bracts, similar to those of the typical form, whereby a more or less distinct neck is produced. The color of the galls is pale green, or sometimes almost white or pale yellowish, the surface being quite pubescent. Their diameter across the widest part ranges generally between 5-8^{mm.}, and their vertical diameter between 4-10^{mm.}.

Var. B. *PHYLLOXERA PURPUREA* Pergande.

This form or variety is in shape between the typical form and var. A. It is of about the same size or somewhat larger than the first. Its base is constricted and the remaining part beyond it

quite conical, with the opening completely closed. The upper side is quite flat, somewhat sunken beneath the plane of the leaf and often most beautifully red, yellowish or paler than the leaf. On the lower side the galls are either pale green or whitish and the surface covered more or less densely with pale pubescence.

STEM-MOTHER.—Length about 0.8^{mm}. Shape oval or pyriform, broadest across the mesothorax, tapering gradually towards the end; slightly indented or constricted beyond the head. Head small, about twice as broad as long, almost half-circular in outline. Eyes very small and blackish. Antennæ and legs pale dusky. The head as well as the body is sparsely beset with medium-sized, rather stout, stiff, spine-like bristles, some of which are placed in rows. A double row of these spines fringe the whole body and are divided as follows: Eight pairs fringe the head, two pairs each side of the pro- and meso-thorax, three pairs each side of the meta thorax and one pair each side of the abdominal segments. Color yellow.

MIGRATORY FEMALE.—Length of body 0.9–1.2^{mm}. Expanse of wings 2.2–2.8^{mm}. Color of both the adult and pupæ, orange. Head, mesothorax, scutellum and sternal plate black, antennæ and legs dusky; eyes brown or dark purple. The prothorax is often faintly dusky and is often marked medio-dorsally with three more or less distinct, minute spots, of which the two smaller, anterior ones, are more or less oval, and the larger, posterior one, linear. Antennæ distinctly three-jointed and about as long as the tibiæ. The two basal joints are shortest, about equal in length and but faintly annulated; the third is much the longest and almost three times the length of the two basal joints combined; it is almost uniform in diameter throughout its whole length, quite straight, with a short pedicel at base and a distinct nipple at tip showing at least two well-marked annulations and provided with three extremely fine hairs at tip. The whole joint is but faintly annulated, the annulations being more numerous and more distinct at its basal fourth. The usual two sensoria are almost obsolete, at least the lower one, which could scarcely be detected, whilst the upper one is very slender and about half as long as the joint. Wings ample, faintly dusky, the veins and stigma darker, the subcosta yellowish at base. Of

the veins the discoidal vein is darkest, and all are bordered with a slight dusky shade. The discoidal vein arises slightly nearer the stigma than the base of the wing and its branch near its middle. The stigmal vein is but slightly curved and arises at about the middle of the stigma. Legs rather short. The tarsi provided with the usual pair of knobbed hairs at the tip of the under side of the first joint and at the upper side of tip of the second joint.

The pupæ are orange, their meso-thorax, wing-pads and three last abdominal segments whitish; eyes and ocelli light cherry brown; antennæ and legs pale dusky. Larvæ and youngest pupæ almost colorless.

PHYLLOXERA NOTABILIS n. sp., Pergande.

Pl. XII., figs. 82-90.

A few galls belonging to this species, growing along the mid-rib of the leaves of the Pecan, *Hicoria olivæformis*, were received July 3, 1877, from Mr. J. Monell, St. Louis, Mo., which bear a general resemblance to those of *Ph. caryacaulis* when growing upon the leaves, though more convex above and more conical beneath, where they split into a number of rather long and slender pubescent bracts or filaments. The color of these galls, which had partly become quite dry, appears to have been somewhat reddish above and green or yellowish beneath. Their shape was more or less oval above and compressed laterally beneath, caused evidently by the drying of the substance. Their largest transverse diameter was 5 to 10 ^{mm}. and the vertical diameter 3 to 8 ^{mm}.

Apparently the same species of galls on leaves of Pecan was received June 1, 1891, from Mr. L. Biedeger, Idlewild, Tex., but, unfortunately, all were empty when received, the contents of most having been destroyed by some Tortricid larva.

The same kind of galls were found during August of 1891 to be very numerous on the leaves of young trees of a variety called

the "Meier Pecan," imported two years prior from Bluffton, Mo., to the Department of Agriculture at Washington, D. C. Numerous additional galls were also received from I. H. Evans, from Austin, Texas.

The fresh galls, as found at Washington, are yellowish-green or slightly reddish, circular and bladder-like, from 2 to 10^{mm} in diameter at the circumference, and from 2 to 7^{mm} vertically; they are convex on both sides and situated either near the midrib or between the transverse veins, and generally more prominent on the upper side with a more or less distinct fovea or dimple about the middle. There is a more or less central nipple or a transverse slit on the under side, from which four to eight or more depressed lines radiate towards the base, along which the gall gradually splits into slender bracts in order to facilitate the escape of the inhabitants. Both sides of the galls are pubescent, though the under side is covered most densely with short, yellowish hairs.

The great majority of these galls contained, besides the stem-mother, numerous eggs and pupæ in various stages of development, numbers of the true sexes, many of which were also observed running about on the outside of the galls, and but one or a few of the winged migrants. This leaves no doubt that most of the sexes were the progeny of the pupæ, whereas the few migrants were destined to perpetuate their species on distant trees.

STEM-MOTHER.—Length 0.6^{mm}. Pyriform, broadest across the thorax, tapering posteriorly and more slightly so towards the head. The head is rounded in front and somewhat notched about the middle. The entire insect is densely covered with acute tubercles, intermixed with a few short hairs. The antennæ are short and about one-fourth the length of the body; third joint slightly clavate and sharply serrate; the sensorial thumb is small and bordered at one side with three circular pores. Color yellowish, eyes purple, legs blackish.

PUPA.—Length about 0.8^{mm}. Color pale orange or lemon yellow, eyes dark brown, ocelli dark red; antennæ, legs, wing-

pads, rostrum and two impressions on the head dusky. They are broadest about the wing-pads, tapering gradually towards the end of the body and covered densely with minute, acute points. Head convex in front and slightly emarginate or notched at the middle. Antennæ slender, almost one-third the length of the body, the third joint thinnest at about its basal third and quite densely serrate or scaly; the upper sensorium is short, elongated and accompanied at one side by two to four circular pores, while the tip is furnished with two or three small hairs. Wing-pads curved outward. Legs and digituli normal.

The eggs produced by the pupæ are pale-yellow, highly polished and apparently without any sculpturing. Those producing the males are about one-third smaller than the female eggs.

MIGRATORY FEMALE.—Length of body 0.6 to 0.8^{mm}. Expanse of wings 2 to 2.4^{mm}. Color yellow to orange; the head, thoracic lobes, scutellum and sternal plate blackish, with some dusky markings on the prothorax. Antennæ and legs yellow, shaded with dusky. Eyes and ocelli black or dark-purplish. Head and thorax faintly sculptured. The antennæ are rather long and slender and almost half the length of the body; the basal joint is about as long as wide and the second slightly longer than wide, narrowest at base and rounded at the apex; both are faintly sculptured. The so-called third joint is distinctly and sharply divided into two separate parts or independent joints: the lower or smaller section, which I designate as the third antennal joint, is sharply truncate at the apex, smooth, cylindrical, slightly curved and usually slightly stoutest near the apex, from which point it suddenly tapers to a short, conical petiole, with two or more sharp annulations. The sensorium of this joint is rather broad, abnormally long and reaches from the apex to the petiole. The terminal or fourth joint is almost twice the length of the third; it is slightly curved and faintly tapering, its base rounded and prolonged in a short, cylindrical petiole, composed of from three to six very fine and sharp annulations; its sensorium is also abnormally long and reaches from near the apex to the rounded base. The sensorial nipple

is minute, near the apex of the joint, and bordered at one side by about four circular pores.

The wings are rather long and broad and of a brownish shade, with the veins and stigma still darker or dusky; both the branch of the discoidal and the stigmal vein are obliterated at base.

The antennal characters of this species are more remarkable than those thus far observed in any of the other Phylloxerini.

SEXUAL GENERATION.—Both sexes are yellow, though the male is somewhat paler and smaller. The eyes are reddish-brown to black; the head, antennæ, legs and pronotum dusky, the rest of the thorax and interrupted band across the abdominal segments still darker.

The sexual female is about 0.4^{mm} in length and slightly over 0.1^{mm} in diameter about the middle. It is elongated and contains but one egg. The third antennal joint is clavate and quite sharply serrate; the sensorial nipple is small and placed near the apex, bordered at one side by one to three circular pores. The body is provided with rows of small hairs.

The male is about one-third smaller and more tapering posteriorly and the genital armature elongate conical. The antennæ are identical with those of the female, except that there is a rather long bristle about the terminal third of joint three. The hairs of the body are also much longer and slightly dilated or capitate at the apex.

PHYLLOXERA GLOBOSUM Shimer.

Pl. XIII., figs. 91, 92; Pl. XIII., figs. 93, 94, var. *coniferum*.

Dactylosphæra globosum Shimer. Proc. Acad. Nat. Sci. Phila., Vol. 19, p. 2.

Dactylosphæra globosum Shimer. Trans. Am. Ent. Soc., 2, p. 392.

Dactylosphæra coniferum Shimer. Trans. Am. Ent. Soc., 2, p. 397.

Phylloxera c.-globosum Thos. Eighth Rep. Nox. and Ben. Ins. of Ills., p. 163.

I have had no opportunity to add anything new to what has been recorded by Shimer, and reproduce such parts of the original description (Proc. Acad. Nat. Sci. Phila., 1867, p. 2 and 3) as undoubtedly have reference to this species, substituting *migratory female* for his term *male*.

In his original description Shimer has confounded this large gall and its architects with those of the rather minute galls of *c.-semen* Walsh, found growing at the time upon the same leaves, notwithstanding that, as he himself states, none of the small galls contained the winged form, but were simply crowded with the so-called larvæ which, as has already been shown, were, without much doubt, the true sexes.

"*Gall* variable in size, often numerous in the parenchyma of the leaf, others on the veins and leaf stalks, all opening on the lower side of the leaf, with a very small orifice: smoothish, of a somewhat leathery structure, pale yellowish-green, glaucous or dark green; sub-globose or sometimes somewhat irregular, without any of the mealy sugary dust within, which is common in galls of the *Aphis* family.

"*Female* [*Stem-mother*] much resembling the 'grape leaf louse' (*D. ? vitifolia*), but smaller, the dull pointed promusculi blackish at the extremity; eyes of few (about five) facets.

"*Eggs* similar to those of the 'grape leaf louse.' Smaller and of a deeper yellow.

Pupa of male [*Migratory female*] orange-yellow, sometimes inclined to greenish; undeveloped wings pale yellow; body somewhat elongate; abdomen pointed; antennæ linear, three-jointed, 1st thick, subglobose; 2d smaller, short, thick; 3d very long, clavate, obliquely pointed, without a spine at the apex, a spine on the inner side of the first and second joints.

Male [*Migratory female*.]—Abdomen and prothorax orange-yellow; mesothorax, head and eyes, blackish; legs and antennæ dark cinereous. Wings hyaline, broad, somewhat overlapping as they lie horizontally on the back. Anterior wing, evenly rounded on the posterior margin; anterior margin rather stright, somewhat curved, convex at the middle of the stigma, apex quite broadly rounded, the wide wedge-shaped base not extending beyond the middle; stigmatic nervure nearly straight, terminating in the centre of the apex, not visible at either end. The discoidal within the middle of the wing, not visible at its outer end, somewhat con-

vex anteriorly, its branch hyaline at its extremities; stigma honey yellow, darkest on the costal margin, the apical end lanceolate; inwardly extending to the base of the wing, all the costal space being of the same color. Posterior wing, one longitudinal vein and no discoidal. Tibiæ and tarsi with a few scattering hairs; claws palish-horn colored, with black tips. Antennæ four-jointed, sublinear, first and second short and thick, the others long, the third on a narrow pedicel, which may be a small joint, fourth clavate. Length to tip of wings .07 inch; body about .025 inch long.

The winged males [females] were numerous, but, as the weather then was very wet, they were in an extremely bad condition, their wings adhering to the walls of the galls and to their own bodies from the excessive dampness in the galls; but among the hundreds observed I saw a number of perfect specimens. Subsequently, in more pleasant weather, I examined several dark green, more perfectly globular galls, located as those observed before, with a good supply of winged specimens in perfect condition. I made careful examination and notes as before, and found that they agreed with the former precisely and compared favorably with the former dried specimens."

Shimer adds (Trans. of the Am. Ent. Soc., Vol. 2, p. 393, Gall No. 10) that this with No. 8 (*caryæ-semen*) "are the only known Hickory galls that have the character of being soft and leathery in structure. The perfect insect was found between Sept. 20th and Oct. 20th, 1866, since which time I have not seen it. I then described it as being found on what I supposed to be *Carya glabra*, but which now proved to be *C. amara*."

"This is manifestly distinct from *caryæ-globuli* Walsh, which is said to mature in June while *globosum* matures in October; and the openings of the galls are quite different in shape, that of *globosum* being round and on a nipple-like projection, while that of *caryæ-globuli* is an elongated slit."

Dactylophera coniferum Shimer, I consider to be but a variety of *D. globosum*.

PHYLLOXERA CARYÆ-GUMMOSA Riley.

Pl. VI., fig. 37; Pl. XIII., figs. 95-97.

Phylloxera caryæ-gummosa Riley. Seventh Rep. Nox. and Ben. Ins. of Mo., p. 118.

Phylloxera caryæ-gummosa Thomas. Eighth Rep. Nox. and Ben. Ins. of Ills., p. 164.

Forming pedunculate, ovoid or globular galls on the under side of leaves of *Hicoria alba*; the gall white or yellowish, pubescent, and gummy or sticky; opening below in a fibrous point. The eggs are almost spherical, pale and translucent. Larva, mother-louse and pupa quite pale, the red eyes and eyelets strongly contrasting. The winged insects with difficulty distinguished from some of the other species, a difficulty made all the greater from the fact that other species get caught in the sticky surface of the gall.

STEM-MOTHER.—Length about 1^{mm}.; elongate pyriform, more than twice as long as broad. Front edge of head somewhat concave and furnished with four short, stiff hairs above, one at base of antennæ and one in front of the eyes; two each side of the thoracic and one each side of the abdominal segments, and from six to eight around the end of the body. Entire surface densely and very finely granulate, with a few more prominent warts on the thoracic segments, each bearing a stout hair. There are also some minute hairs, sparsely set, along the posterior margins of the abdominal segments. Antennæ as usual, with the third joint about twice the length of the two basal joints combined, and of almost uniform diameter throughout. Thumb very short. Surface indistinctly scaly and annulated.

GROUP III.

21. *Forming elongate folds along the veins beneath, with corresponding ridges or carinæ above Ph. caryævenæ* Fitch.

There is but one species in our fauna representing this group.

PHYLLOXERA CARYÆVENÆ Fitch.

Pl. VI., figs 38-39; Pl. XIII., figs. 98-105.

Pemphigus? caryævenæ Fitch. Third Rep. Nox. and Ben. Ins. of N. Y., Section 164, p. 126.

Phylloxera caryævenæ Riley. Eighth Rep. Nox. and Ben. Ins. of Mo., p. 117.

Phylloxera caryævenæ Thomas. Eighth Rep. Nox. and Ben. Ins. of Ills., p. 162.

The galls of this species are readily separated from those of any

of the other species found upon *Hicoria*. They resemble more closely those of certain of the *Cecidomyidæ* occurring on different species of oaks and other plants.

They always form, either along the main rib or more frequently along the transverse veins, shorter or longer folds or plaits projecting more or less evenly from both sides, though usually more prominent above, where they form elongate ridges or carinæ, which are often transversed by 3-5, or more, short, elevated branches, about equal in length to the diameter of the gall. The opening or slit is always on the underside and, while fresh, is tightly closed except at the outer end, and covered by a delicate white or greenish pubescence which also more or less completely covers the entire surface beneath. The color is generally yellowish-green, though very frequently also brownish or purplish. Two or more are often confluent, so that their length varies from 6-14^{mm}. or more, and their diameter from 2-3^{mm}.

The gall begins to form early in May. It occurs not only upon *Hicoria tomentosa* but upon several other species of *Hicoria* and is widely distributed over the eastern half of the United States, having been observed from New York to Florida, and west as far as Illinois and Missouri.

No winged migratory female has yet been observed, but the most remarkable fact is that I have been unable to discover in any of the many galls examined from 1880 to 1890 a sexual form, though examinations were made during different months. The only occupants thus far found in these galls were the true stem-mothers (of which 1-3 have been observed in the same gall), their eggs and the wingless sexuparæ in different stages of development.

By the middle of August, when the majority of the galls had become dry and empty, but a few remained still green and contained the still living, though much shrunken, stem-mother, a small number of eggs and a few larvæ, but no migrants or sexual individuals.

On July 19, 1890, when many of the galls still contained their usual inhabitants, extended and careful search was made to discover the whereabouts of the larvæ after leaving the galls. Small colonies, absolutely identical with those found within the

galls, were finally discovered snugly hid away either in deep cracks of the bark or at the bottom of deep and more or less completely closed depressions, which are found on the trunk and stouter twigs and which are caused by the decay and dropping out of small branchlets. Here the insects live upon the juices from the tender bark which forms at the bottom of the cavities. These colonies usually consist of the stem-mother, a number of fully grown apterous females and larvæ (both the direct progeny of the stem-mother) and *eggs of three different sizes*. The smallest, and most numerous of these eggs, correspond exactly in size and general appearance with those deposited by the stem-mother in the galls, while the others are about twice as large but yet of two sizes, the larger ones of a regularly ovoid shape, the smaller more conoidal in outline. The former produce, after a few days, the true sexual female, and the latter the male, which pair, when the female brings forth her single impregnated or winter egg which doubtless hibernates within the cavity.

In some of the depressions no stem-mother is found, but only the other forms here described and a few of the winter eggs.

STEM-MOTHER.—Length of body 0.8–1.2^{mm}. Shape broadly ovoid, or almost globular. General color pale yellowish, growing gradually darker while increasing in age. Antennæ, legs and rostrum pale dusky. Eyes, blood-red, composed of three ocelli each side, arranged triangularly on a conical prominence. Antennæ with the first joint stoutest and about as long as wide; the second somewhat more elongate, stoutest at anterior end; both together somewhat shorter than the third; joint 3 slender and tapering slightly toward both ends and divided by 5–8 more or less distinct serrations; the thumb minute and movable; tip blunt and provided with three fine and short hairs. Surface of body covered with minute granulations, and ornamented in addition with six rows of small and somewhat conical, and slightly dusky tubercles; five similar tubercles each side of the head provided with a minute hair. Head short, almost twice as broad as long and more or less distinctly separated from the body.

EGG FROM STEM-MOTHER.—Length 0.2^{mm}, and about 0.1^{mm} in diameter. Ovoid, highly polished and apparently without a trace of sculpture. White, or with but the faintest yellow tinge.

APTEROUS SEXUPARA.—Length of body about 0.6^{mm} . Shape elongate-ovoid. Color whitish, pale yellow or greenish-yellow, with the members and warts dusky. Eyes dark purplish-red. Surface of body densely covered with minute points. The dorsal warts are normally placed, though faint, those on the thorax round, with the intermediate one each side on pro- and mesothorax obsolete, leaving on each of these joints but two transverse rows of four each, while the single row on metathorax has six. On the abdomen the two medial rows are transversely elongate. In some specimens these warts are very distinct and readily observed, while in others they become more or less obsolete, and on the abdomen they are more or less confluent towards tip. Antennæ short and very similar to those of the stem-mother; the third joint scarcely longer than the two basal joints combined, somewhat curved, thinnest at base, with but few and indistinct annulations; the thumb rather stout and close to the tip of the joint. When young the rostrum projects beyond the end of body.

SEXUAL FEMALE.—Length of body slightly less than 0.2^{mm} . Shape broadly ovoid, with the last two segments much narrower than the rest of the body. Mouth rudimentary, broad and rounded at tip. Color yellow; eyes purple; antennæ and legs faintly dusky. The antennæ are extremely short, the third joint but slightly the longest, and the second slightly shorter than the first. Joint 1 stoutest, of uniform diameter, truncate anteriorly; joint 2 but slightly narrowing at base; joint 3 also narrowest at base, bluntly rounded at tip and provided with a slender hair, its surface faintly annulate; the thumb minute, though distinct and placed close to the apex.

MALE.—The male is about one-fourth smaller, and narrower than the female. Antennæ, legs and genital armature rather stout. Color pale yellow; eyes brown.

WINTER-EGG.—Length slightly less than 0.2^{mm} . Shape ovoid, sometimes faintly curved, somewhat flattened, dark, dull, grayish-yellow or green, ornamented with rather coarse and deep, more or less irregular, transversely oval pits.

During the summer of 1902 another effort was made by me to discover, if possible, the winged migrant of this species, though

without avail. Unfortunately nearly all the trees on which the galls used to be plentiful had been cut down, leaving but a few small shrubs in that particular locality, with still fewer galls on some of the leaves. These galls were also extremely scarce on trees in the woods some distance to the north, in all of which the usual apterous forms and some eggs were present, though not a single one of the winged migrants. That this form, after a shorter or longer interval must exist, seems quite plain, while otherwise the species is doomed to become extinct, since the migration of some of the apterous forms from tree to tree, especially if such trees should grow at some distance from each other, must naturally be rather slow and uncertain. I take it, therefore, for granted that the spread of this species depends, as in other species, on a winged migrant, which sooner or later will be found.

GROUP IV.

TWIG OR PETIOLE GALLS.

This group comprises a series of more or less closely related galls, growing principally on the youngest twigs and petioles. Some of them resemble each other so closely that it is frequently difficult to separate them, particularly after they have become dry, though the insects producing them often differ markedly.

For convenience these galls may be divided into three sections.

- I. *Galls more or less globular. Orifice completely closed when young; splitting into 3-6 or more irregular bracts when mature and leaving an irregular opening.*
22. Globular or oval; often more or less conical; spiny or smooth according to the tree on which they grow, and more or less confluent. Size varying from 5-25^{mm}. *Ph. caryæcaulis* Fitch.
23. Globular; covered densely with long and fleshy filaments. Size 5-15^{mm}. *Ph. spinuloides* Pergande, n. s.
24. Size medium; growing in larger or smaller clusters, and apparently deformations of the flower and leaf-buds. Splitting when mature into four or more broad bracts. Surface smooth. Size 3-15^{mm}. *Ph. devastatrix* Pergande, n. s.
25. Size medium; smooth; growing in clusters; usually with a short, stout, nipple-like projection on one side. Diameter 5-10^{mm}.
. *Ph. georgiana* Pergande, n. s.

26. Large, oval, smooth; growing upon the petioles. A slight central depression, covered with short hairs. Length about 20^{mm}, diameter about 10^{mm}. *Ph. subelliptica* Shimer.
- II. *Galls more or less globular or irregular, terminating in a tooth-like nipple.*
27. Growing on tender twigs, petioles or ribs of leaves, often confluent. Smooth. Diameter 2-8^{mm}. *Ph. perniciosa* Pergande, n. s.
- III. *Galls more or less reniform. Opening when mature in a transverse slit.*
28. Growing on the petiole or midrib of the leaves, the transverse slit dividing the gall in two halves. *Ph. c.-ren* Riley.

PHYLLOXERA CARYÆCAULIS Fitch.

- Pl. VII., fig. 40; Pl. XIV., fig. 106; *caryæcaulis*;
 Pl. VII., figs. 41-42; Pl. XIV., fig. 107; var. *magna*;
 Pl. VIII., figs. 43-44; Pl. XIV., figs. 108-114; var. *spinosa*;
 Pl. XVI., figs. 124-127; var. *spinosa*.

Pemphigus caryæcaulis Fitch. Third Rep. Nox. and Ben. Ins. of N. Y., p. 126 and 163.

Dactylosphæra caryæ-magnum Shimer. Trans. Am. Ent. Soc., 2, p. 391.

Dactylosphæra spinosum Shimer. Trans. Am. Ent. Soc., 2, p. 397.

Phylloxera caryæcaulis Riley. Seventh Rep. Nox. and Ben. Ins. of Mo., p. 117.

Phylloxera caryæcaulis Thos. Eighth Rep. Nox. and Ben. Ins. of Ills., p. 160.

Up to the present time these three forms of galls have been considered as quite distinct species on account of their dissimilarity, two of them being smooth and the other more or less profusely covered with fleshy spines. But a careful study of the architects of these forms forces the conclusion that they are identical, there being no tangible characters by which to separate them. The spiny form of gall always grows upon trees with pubescent leaves, such as *Hicoria tomentosa*, while the smooth forms are always found upon trees with smooth leaves, such as *Hicoria glabra*, *amara* and probably other species.

The typical form, growing upon the young and succulent limbs, petioles or the midrib of the leaflets of *Hicoria glabra*, occurs over the eastern half of the United States.

The size of the galls varies from 5-25^{mm.} in diameter. Those growing singly often attain immense proportions, but when numerous or crowded they are reduced in size and often confluent, so as to form an elongated mass. Before maturity of the inhabitants the gall is closed, but as soon as any of the inmates have acquired wings, it cracks transversely into 3-6 or more broad and more or less irregular bracts so as to allow the mature migrants to escape, and to leave room and food for the younger individuals. The color is pale yellowish-green, more or less tinted with red or crimson. The walls of the galls are rather thick and succulent when young, becoming more tough and leathery when older and hard, brown or black when empty and dry.

STEM-MOTHER.—Length when fully grown 0.8-1.8^{mm.} and about 0.6-1.2^{mm.} in diameter; often almost globular. The color varies, according to age, from greenish-yellow to brownish-yellow, with a faint dusky shade. Eyes dark purple; antennæ and legs blackish. Two transverse, more or less distinct frontal foveæ, dusky. The whole surface of the body is quite densely covered with extremely minute, sharp points, most dense, and arranged in rows, on the abdominal segments. Antennæ rather short, the third joint of about uniform diameter, scarcely twice the length of the two basal joints combined and divided by about 8-13 more or less distinct and coarse annulations; the thumb small, though quite distinct and apparently movable.

EGG.—Elongate-ovoid, colorless or faintly greenish, polished and translucent.

LARVA.—Either colorless or faintly yellowish, or yellowish-green, with the eyes red. Surface of body profusely covered with minute tubercles, each provided with a short hair.

PUPA.—The youngest pupæ are pale greenish-yellow and the older ones pale orange, with the antennæ, legs and external edge of wing-cases dusky. Eyes and ocellar spots reddish.

MIGRATORY FEMALE.—Length of body 1.2-1.8^{mm.}. Expanse of wings 3.4-3.8^{mm.}. Color paler or darker orange; the prothorax darkest, marked more or less distinctly with either two transverse spots or a continuous line near anterior margin, a transverse, medio-dorsal, more or less curved spot, often divided at middle, a

smaller round spot usually occurring each side of it, and broad anterior angles, all dusky. Anal part marked with two generally quite distinct, oval, orange spots which turn brown or black in specimens mounted for some time in balsam. Eyes brown, ocelli clear. Head black, its posterior portion usually yellow. Prothorax finely but rather densely rugose. Antennæ, mesothorax and sternum black. Legs and wings dusky. Wings large, broad; the subcosta, stigma and veins darker, the latter with a brownish shading on each side. Course of veins normal, the stigmal vein straight, connecting near the base of the stigma. Antennæ rather slender, the first joint stoutest and somewhat longer than wide, not, or but faintly, annulate; the second slightly shorter, narrowest at base, rounded at apex, divided by five or six scaly annulations; the third slender, its upper half scaly and the lower half annulate and more or less distinctly scaly; basal portion of the joint considerably constricted above the basal sensorium; anterior sensorium about one-half the length of the joint, the basal one small and round.

Ph. spinosa Shimer is evidently but a variety and more numerous than the typical form in localities where the pubescent-leaved species of Hickory prevail. It is often considerably larger than the typical form and is always more or less covered with short, fleshy spines. It closely resembles, also, *c.-spinuloida*, which, however, is still more densely covered with longer and more slender spines. The more striking differences are, however, noticeable in the migratory females, which in *caryæcaulis* have shorter and broader wings, different antennal characters, comparatively longer legs and the two oval orange or blackish spots at the end of the body.

Ph. c.-magna Shimer (Trans. Am. Ent. Soc., 2, p. 391) may also be considered as a variety of *caryæcaulis*. The form is found in Missouri growing on the petioles and bases of the leaflets of *Hicoria amara*. Some of the specimens also closely resemble those of *subelliptica* Shimer, which probably belongs to it, but of which I have not yet succeeded in obtaining the migratory form. On account of some slight differences in the gall, which are no doubt due to the specific differences of the infested trees, *c.-magna* may perhaps be allowed to remain under a variety name, though the

architects in their different stages, as far as examined, show no differences by which to separate them from the typical *caryocaulis*. The galls of this variety vary from 4–20^{mm} in size, the normal being about 10^{mm}. They occur on the under side of the petiole and the base and often the midrib of the leaves, and, when in the latter position, they generally project somewhat on the upper side. The shape varies from globular to sub-conical, or broadly ovoid. The surface is quite densely covered with a minute pubescence which gives it a slightly velvety appearance. The orifice beneath is rather small and transverse and tightly drawn together before maturity. Color greenish-white to yellowish-green beneath and beautifully crimson on the upper side. Usually single, though occasionally two or more may become confluent, with their cells, however, well separated.

PHYLLOXERA SPINULOIDA Pergande, n. sp.

Pl. XVII., figs. 128 130.

The galls of this species, as already remarked, are very similar and closely related to those of *spinosa*, for which, without comparison of the migratory females, they might easily be mistaken. They are, as a rule, more regularly globular, or but slightly conical, covered with numerous irregular, more or less radiating, low ridges, which are rather plentifully provided with irregular, long, fuzzy, fleshy spines or filaments. They grow generally upon the petiole of the leaves, which they often almost completely encircle, causing, at the point of junction with the petiole, a curve or bend. They also occur on the midrib of the leaves. When mature each gall bursts at the apex in a more or less irregular opening. The diameter of those examined varied from 5–15^{mm}. The color appears to be quite uniformly greenish-yellow, or brownish-yellow on one side.

MIGRATORY FEMALE.—Length of body 0.6–1.8^{mm}. Expanse of wings 3.6–3.8^{mm}. Color orange. Head, antennæ and legs dusky. Meso- and metathorax and sternal plate purplish-black. Eyes black. Ocelli clear and with a blackish border at the inner side. Prothorax marked with three pale dusky spots, of which the two smaller are placed in front. Antennæ slender, scaly, the two basal joints nearly equal in length: joint 2 almost globular,

with five or six scalloped or $\frac{1}{2}$ scaly annulations; joint 3 variable, even in the same specimen. In some specimens that portion between the anterior and posterior sensoria is almost one-half longer than usual, while in others a smaller but very distinct projecting intermediate sensorium may be observed just below the anterior sensorium. Wings large, distinctly dusky or brownish; veins and stigma darker; all veins bordered with a dusky shade. Stigmal vein straight, connecting with the stigma near its base.

Found at Georgiana, Fla., on Hickory (species not determined). The migratory females leave the galls from about the middle to the end of March.

PHYLLOXERA DEVASTATRIX Pergande, n. sp.

Pl. XVII., figs. 131-135.

The galls of this species resemble very closely the smaller galls of *caryocaulis* and also those of *perniciosa*. From both of these, however, the species differs markedly in the antennæ of the winged form, which are much more slender than in either of the other two, with scarcely a constriction above the lower sensorium and with the anterior sensorium much shorter.

Its principal points of attack, as in the other species of this group, are the tender twigs, petioles and the midrib of the young leaves; but the leaf-buds and flower-buds are also often involved so as to prevent the setting of the fruit.

It appears to be an exclusively western or southwestern species, infesting the Pecan-hickory (*Hicoria olivæformis*) during May and early June. This gall was first received in 1887 from Mr. M. E. Winster of Staunton, Adams County, Miss., and again in 1889 from Mr. H. M. Johnson of Marston, La., with the statement that it was greatly damaging the trees. It is either globular or more or less irregular in shape, especially where much crowded. Before opening it is often provided with a short more or less distinct nipple, most prominent in the younger galls, and becoming almost obsolete in the more mature form, when its position is indicated by a more or less densely pubescent spot. It splits transversely into four or more broad bracts, similar to those of *caryocaulis*. The size varies from 3-15^{mm}. Surface smooth, green or yellow-

ish-green, and often beautifully red on one side while young, turning brown or black and soon drying up after the architects have left.

MIGRATORY FEMALE.—Length of body about 1.2^{mm}. Expanse of wings 3.4–3.6^{mm} or more. Color paler or darker yellow, the head, mesothorax and sternum black or brown, the antennæ and legs dusky, the eyes brown or black. Antennæ long and slender; joint 1 longer than wide and of uniform diameter; joint 2 more slender than usual, of almost uniform diameter, rounded at tip, with more or less distinct scaly annulations; joint 3 long and slender, its anterior sensorium only about one-fourth the length of the joint; the lower one very small, often almost obsolete; greater part of the joint, at least as far as to the anterior sensorium, distinctly and quite coarsely annulate, the rest being scaly. This joint is often quite irregular in shape, the more common form as represented in the figure. Head and thorax finely rugose; the abdomen quite densely and finely striate, the striae closely lined with minute sharp points. Legs rather long and robust. Wings large, rather broad, pale dusky or brownish; stigma and discoidal vein darker; the discoidal branch and the stigmal vein sometimes almost obsolete; all more or less shaded. Sometimes the stigmal vein passes the stigma and connects with the discoidal vein near its base. The hind wings are also large and rather broad and their subcostal vein sometimes almost completely obliterated.

PHYLLOXERA GEORGIANA* Pergande, n. sp.

Plate XV., figs. 115–117.

The galls of this species closely resemble those of *Ph. devastatrix*, being of the same shape, size and color; but the winged form is quite different and may readily be distinguished by its much paler wings and venation and particularly by the shorter antennæ and much larger sensorial membranes of the third joint.

The galls grow either singly or in close clusters upon the tender twigs and petioles and often recall in appearance the galls of *Cynips q.-ficus*. Those growing in clusters are more or less irregular in shape, whereas those growing singly are quite globular

and frequently provided with a short nipple. Their size varies from three-sixteenths to one-half inch in diameter; color either uniformly greenish-yellow, sometimes reddish on one side or around the base, or entirely dark red.

STEM-MOTHER.—Length 1–1.6^{mm}. Color orange. Antennæ and legs blackish. Pyriform, broadest across the mesothorax. Surface of body closely covered with minute sharp points and the anal end furnished with 6–8 rather stout bristles. Eyes small, projecting, composed of 3–5 or perhaps more simple, colorless, eyelets. Antennæ rather long and slender, the first joint stoutest, wider than long, of uniform diameter, truncate at tip, with a slender bristle near the apex; joint 2 rather more slender, longer than wide, most slender at base, rounded at anterior end and also furnished with a bristle; joint 3 about thrice the length of the other two combined and divided by about eighteen rather coarse and more or less irregular annulations, the last bearing a short bristle; terminal sensorium very small and oval.

MIGRATORY FEMALE.—Length of body 0.8–1^{mm}. Expanse of wings 3–3.6^{mm}. Color orange. Head, meso- and metathoracic parts and sternal plate blackish. Eyes black, antennæ and legs dusky. Head and prothorax rugose, the rugæ of the head somewhat the coarsest. Antennæ rather stout, joint 1 about as long as wide, indistinctly scaly or annulate; joint 2 slightly longer than wide but slightly narrower at base, rounded at apex and distinctly scaly; joint 3 sharply annulate at about its basal half, the anterior portion scaly; anterior sensorium about one-half the length of the joint, though sometimes either somewhat longer or shorter; the basal sensorium rather large and subcircular. Wings large and broad, very pale or but faintly dusky, the veins somewhat darker and with fuscous shades; stigma yellowish.

PHYLLOXERA SUBELLIPTICA Shimer.

Plate XV., figs. 118–119.

Dactylophæra subellipticum Shimer. Trans. Am. Ent. Soc., 2, p. 389.

Of this species I am familiar with the gall only and reproduce, therefore, Shimer's description as published in the Transactions of

the American Entomological Society of Philadelphia, Vol. 2, 1868, page 389 :

"On June 7th I observed, placed in the common petiole of the leaf, large, elongate, subelipsoidal, nut-like galls, of a deep leaf-green color, mottled with paler green, and somewhat nodulated; some were irregular, being on the side of the stem; but most of them are quite regular in form and completely surrounding the stem; in these latter the leaves are very much dwarfed. The opening is on the middle of the side, slightly elongate, but at this date so close as to be scarcely apparent. These galls contain capacious cavities, in which were found vast colonies of larvæ, and an abundance of eggs. Transverse diameter five-eighths inch; conjugate diameter three-eighths inch.

"By June 20th these galls had considerably changed in appearance, being contorted into different shapes; they had began to crack open, having transverse fissures on their outer surface. The first one opened contained many hundred winged imagos, all dead, and in the midst of them was a large syrphidian larva. I found only one gall that contained perfect living imagos, the inhabitants of all the other galls that were examined having been destroyed by various enemies."

"*Dactylosphæra subellipticum* n. sp.

"*Winged Imago*.—[*Winged female*].—Large and robust, blackish, with abdomen light yellow; antennæ and legs blackish; wings hyaline. Length of body .06-.07; to tip of wings .08-.09 inch.

"*Mother Insect*.—[*Stem-mother*].—Rugose, greenish-yellow; antennæ and legs black; otherwise like that from gall No. 1 [*Dactylosphæra hemisphericum*]. Length .06; breadth .04; thickness .03 inch.

"The winged imago of this species is the largest yet observed, and the eggs are more nearly globular than those found in other species of galls."

This may possibly be but a variety of *Ph. caryæcaulis* Fitch, but not having had an opportunity to study its architects I prefer, for the present, to leave it as a distinct species.

PHYLLOXERA PERNICIOSA Pergande, n. sp.

Pl. VIII., fig. 45; Pl. XV., figs. 120-123.

Pl. XVIII., figs. 136-140.

This is one of our most destructive species, occurring in the District of Columbia, Maryland, Virginia and Pennsylvania, where it takes the place of *Ph. caryæcaulis* and *Ph. magna*, having the same habit and there proving as disastrous to the foliage of *Hicoria tomentosa* as those prove in the North and Northwest to the other species of *Hicoria*. It attacks, as do those species, the

tender twigs and petioles and the different parts of the leaves at times in such immense numbers as to completely deform and cause them to dry up and drop to the ground, literally, at times, defoliating the tree. My attention was first called to this particular species in May, 1883, when, passing through a strip of woods bordering the Potomac River in Virginia, I observed that the air was swarming with the migratory form. The insects were settling not only on the leaves of the different species of *Hicoria*, but on all other kinds of trees and shrubs and even on weeds, on all of which they were actively engaged in depositing their eggs; but they all originated from a tall slender tree of *Hicoria tomentosa*, every leaf, petiole and young twig of which was affected by the galls.

By May 27th the eggs were found upon the leaves of all sorts of vegetation, generally on the under side, along the midrib and the larger veins, and particularly in the angles where the veins ramify. Yet many were deposited indiscriminately on all parts of the leaves.

By June 1st every leaf upon the gall-covered tree was beset with hundreds of eggs, while numbers of winged females were still actively engaged in ovipositing.

On June 4th these were still numerous, but the earlier deposited eggs were already hatching. A careful study of the insects from these eggs proved them to be true males and females, the males about 50% more numerous than the females. The male is quite active, running briskly about, while the female is more sluggish and inclined to be stationary. She is about twice the size of the male and contains a single large egg. By this time large numbers of the leaves affected were dropping, and the ground for some distance around the tree became covered with them. No winter eggs had, up to this time, been noticed and but few of the sexed individuals were seen upon the branches and upon the trunks.

On June 8th the sexes were still numerous and active, the males still outnumbering the females. They could not be found on or under the bark of the tree anywhere within easy reach, though they were abundant under the old and rotten leaves lying

on the ground, and a considerable number could be found on the stumps of old *Hicoria* and other trees and in the cracks of the soil.

On June 12th the first winter eggs were discovered, most of them upon twigs that had been infested with galls. They were most numerous in old galls, in the cracks around and about them and in the old bark, often as many a fifty packed closely together intermixed with the dead and empty skins of the females. They were also found in the depressions caused by the shed leaves of the previous year, as also at the base of the new growth, especially where surrounded by a fringe of hairs, under and between which the eggs were thrust; also in the angles formed by the petioles and upon the twigs, in the old, dead and rather hairy or fuzzy buds, and, in fact, in any crack or perforation upon the tree. Some were even found between old leaves on the surface of the ground and under the loose bark of a piece of old grape-vine lying beneath the tree; in the sheltered places afforded by an old oak stump near by, as well as under the loose bark of a Dogwood (*Cornus florida*).

On June 19th a more careful examination of the trees showed that the eggs became more numerous as one ascended the tree. At a distance of about thirty feet from the ground they were extremely abundant, being closely packed under the loose bark of dead twigs, in crevices and under and between lichens growing upon the trunk.

None of the eggs had hatched on July 18th though large numbers had been destroyed by various natural enemies, especially by different mites belonging to the genera *Tyroglyphus*, *Rhizoglyphus*, *Hyppopus*, *Scirus*, *Nothrus*, and *Oribata*. An examination July 30th showed that none of the eggs had yet hatched.

November 20th they were still unhatched but sound.

February 6th, 1884, they were again examined and found to be in good condition.

On March 15th none had yet hatched.

On April 1st, notwithstanding the devastations of the mites before mentioned, and other destructive agents, a number of sound eggs remained. At this time they were somewhat more yellowish than in the previous autumn, rather more swollen and smoother,

though the sculpture was still visible; the eyes of the embryo were now easily seen through the shell, and by the 12th of April or coincident with the first bursting of the buds, these eggs began to hatch in large numbers, the young stem-mothers running briskly in search of a suitable position to settle down and to found the colonies.

By the 15th of April most of the eggs had hatched. By the 28th of April most of the young stem-mothers had settled either on the young petiole or mid-rib, on the cross-rib, or on the more fleshy parts of the young leaves, where small depressions or cavities had been formed.

By May 8th it was noticed that the galls had been formed on almost all parts of the leaves or on the petioles or on the more tender twigs. The more perfect specimens were growing singly, resembling a blunt tooth or thorn, those on the leaves projecting about evenly on both sides though ordinarily more prominently on the under side. The stem-mother had already by this time acquired full growth and began depositing numerous eggs, covering almost the whole inner surface of the gall, the eggs placed on end and side by side reminding one in miniature of the regular crystallizations in the cavities of some geode. By the 18th of May the galls contained, besides the eggs, both larvæ and pupæ in different stages of development. By the 25th the winged insects had formed and were leaving the galls in large numbers and settling, as at the same time the previous year, on all kinds of vegetation in the neighborhood of the tree on which they had developed.

To sum up the life-history of this species, the winter or impregnated eggs are deposited early in June in all sorts of sheltered positions, especially on the upper portions of the tree; they hatch early in April of the following year, remaining dormant some ten months. The stem-mother attains maturity and begins ovipositing in about twenty days after hatching, while the winged migratory females (sexuparæ) mature and begin to leave their galls in about twenty days after the first eggs are laid. The first sexual individuals appear about ten days subsequently and some ten days further elapse before the true female, after pairing, begins to consign her single egg to its winter quarters.

Hence there are but three annual generations produced, viz., the apterous and parthenogenetic stem-mother, the migratory or winged sexuparæ and the apterous sexed individuals: and all the direct issue from the stem-mother become sexuparæ. This, as already stated, may be looked upon as the normal mode of the development of the majority of the gall-producing species on Hickory. Yet there are exceptions, and our *Hicoria* species present some of the varying biologic features already known in other species of the sub-family and have, in addition, others which are peculiar.

STEM-MOTHER.—Recently hatched. Length 0.3^{mm} . Color yellow. Eyes reddish-brown with a clear, colorless ocellus at their middle. Antennæ, legs and rostrum dusky, the last joint of the rostrum yellow. Body elongate-ovoid. Antennæ stout, the terminal joint with apparently five annulations and with a thumb, externally, near tip. Tarsi with strong claws and digituli. The rostrum stout, reaching a little beyond the posterior margin of the metasternum.

MATURE STEM-MOTHER.—Length $0.8-1^{\text{mm}}$; diameter across mesothorax 0.6^{mm} . Shape broadly pyriform, broadest across the mesothorax. Color grayish-green or yellow, with the sutures slightly darker. Antennæ and legs blackish. Surface of the body densely covered with minute, pointed granules. Front of head somewhat concave, lined with four short and rather stiff bristles. Antennæ short, joint 3 about twice the length of the others combined, of uniform thickness, slightly curved and quite coarsely scaly: the thumb short, very distinct, inserted just below tip. Legs and rostrum stout, the latter reaching to middle coxæ. The eggs deposited by the stem-mother are quite transparent, highly polished, without any sculpturing, and faintly yellowish or greenish.

PUPA.—Length about 1^{mm} , diameter across mesothorax 0.4^{mm} . Color orange, lemon-yellow or yellowish-green, the thoracic segments darkest. Antennæ, legs, rostrum and wing-pads more or less dusky. Eyes and ocellar spots red. Dorsal surface closely and curiously sculptured, being covered with minute, slightly dusky warts, which terminate either in one or often in as many as five or six small scale-like points, these again often provided

at apex with minute teeth. Antennæ very stout, the third joint somewhat narrowed towards tip and somewhat scaly. Legs stout.

MIGRATORY FEMALE.—Closely related to both *Ph. c.-spinuloides* and to *Ph. spinosa*, from the first of which it differs principally in the structure of the antennæ, and from the latter in the absence of the two dark, oval spots at the end of the abdomen.

Length of body 0.8–1.6^{mm}; expanse of wings 2.6–3.4^{mm}. Color yellow; head, meso- and metathorax and sternal plate dull blackish. Sides of prothorax and three spots on its disc dusky, the posterior one transverse and largest. Eyes red, ocelli colorless, bordered at their inner side with black. Antennæ and legs dusky, the legs palest. Antennæ rather slender and very variable in shape. Joint 1 stoutest, about as long as 2 and faintly scaly; joint 2 about as long as wide or but slightly longer, rounded at anterior end, its surface distinctly scaly; joint 3 rather slender, its basal section subject to the greatest variation, being either extremely slender and scarcely half the usual diameter, or curved and bent in different directions, in which respect it is unlike anything observed in this genus before. There is also considerable variation in the sensorial membranes, the basal one being often almost completely obliterated, whereas the terminal one shows more or less a tendency to divide into several independent parts. In this respect it resembles *Ph. c.-spinuloides*. The whole surface of this joint is always more or less distinctly scaly. Surface of head and prothorax finely rugose, the rugæ rather shallow. Wings rather large, pale fuscous; the stigma and veins darker; the stigma with a more or less yellowish tinge. Venation normal and bordered with a dusky shade.

SEXUAL EGGS.—The sexual eggs are of two different sizes. Those producing the males measure 0.3^{mm}, and those producing the females 0.4^{mm} in length. All are regularly ovoid, highly polished, faintly faceted and granulate and of a pale lemon-yellow color.

MALE AND FEMALE.—Length of male about 0.2^{mm}; of female 0.4^{mm}. Color of both sexes greenish-yellow, though the male is usually somewhat the darker. Eyes brownish, antennæ and legs pale dusky. Mouthparts wanting.

WINTER EGG.—The length of the winter-egg is about 0.2^{mm}.

Rather stout, ovoid, slightly curved and curiously sculptured, so as to recall four-leaved rosettes. Color rather dull greenish-gray, rendering detection very difficult.

PHYLLOXERA CARYÆ-REN Riley.

Plate XVIII., fig. 142.

Phylloxera caryæ-ren Riley. Seventh Rep. Nox. and Ben. Ins. of Mo., p. 118.

Phylloxera caryæ-ren Thomas. Eighth Rep. Nox. and Ben. Ins. of Ill., p. 164.

Since the description of this gall nothing new has been added regarding its earlier stages and development: nor have I had the opportunity of studying its architects.

The galls usually grow, like those of the preceding species, in clusters, though occasionally singly, upon the main petiole, the leaf-stems or the midrib of the leaves of *Hicoria glabra*, usually along the underside. Frequently, however, they are so closely crowded together as to completely encircle the petioles, never becoming confluent, however. They are always placed transversely with the axis of the petiole, more or less distinctly reniform and divided along their entire transverse length in two equal halves or lids, the edges of which are incurved and pressed closely together while young, but spread open for some distance when mature to allow the insects to escape. The size varies from 2-15^{mm} and the outer surface is densely pubescent and of a pale green color, with the interior smooth and yellowish-brown. The walls are rather thick and hard and similar in composition to the husks of the nuts.

ADDITIONAL SPECIES OF PHYLLOXERA INHABITING VARIOUS
OTHER TREES.

PHYLLOXERA CASTANÆÆ Hald.

Plate XVIII., figs. 143-150.

Chermes castanææ Hald. Am. Journ. of Sci. and Arts, 2nd Ser., Vol. IX., 1850, p. 108.

Phylloxera ? castaneæ Fitch. Third Rep. Nox. and Ben. Ins. of N. Y., 200, p. 154, 1859.

Haldeman's original description is as follows:

"*Chermes castaneæ*. — Flavous, thorax, pectus, and eyes black; wings translucent, inner half of the stigma scarcely discolored; 1st and 3rd transverse nervure normal; 2nd arising from the middle of the 1st and terminating in the normal position; posterior wings without nervures; feet and antennæ pale fuscous. The wingless individuals are entirely flavous, with the eyes rufous. Inhabits both sides of the leaf of the chestnut, forming lines along the midrib, and causing the leaf to curl. Pennsylvania in August and September."

Since the discovery of this species by Haldeman, in 1850, all trace of it appears to have been lost, at least so far as published records indicate. In July, 1883, I found it in large numbers on terminal, or younger leaves of a low shrub of *Castanea vesca* near Laurel, Md., on which it produced a distorted, twisted and sickly appearance of the leaves, the insects being closely crowded along the midrib on the under side of the leaves in different stages of development, including the winged sexuparæ.

Among the pupæ of this species were observed two quite distinct forms, one of them resembling somewhat those of *Ph. rileyi*, for which they might readily be mistaken, though the antennal differences of the winged females are pronounced. In *Ph. rileyi* these organs have a prominent constriction or indentation near the base of the third joint, similar to that of many of the Hickory species, whereas in *Ph. castaneæ* this joint is of almost uniform diameter throughout, without a constriction.

The principal differences between these two forms of pupæ will be observed in the tubercles. In one form, even in the smallest specimens, these tubercles are extremely long and slender, especially those surrounding the entire body, while in the other form all tubercles are much reduced in size, and almost obsolete, in some specimens, on the abdomen.

That one of the forms of this species here treated of is identical with the one described by Haldeman there can be scarcely any doubt whatever, notwithstanding his statement that the posterior wings are without a nervure. He simply refers to the discoidal veins, which are always wanting in the genus, though there is a distinct subcostal vein which he overlooked.

I append herewith a more detailed description of the different forms observed.

APTEROUS FEMALE.—Length about 1^{mm}. Color pale yellow. Eyes red. Antennæ and legs finely dusky. Body elongated, having four short and stout capital tubercles, two of them frontal and the other two just behind them; surface indistinctly rugose and densely granulated. Antennæ with the third joint slender, narrowest at base, divided by about 15–18 rather shallow and somewhat scaly annulations; its tip truncate and provided with apparently two fine hairs; thumb minute, though distinct.

EGG.—Length about 0.2^{mm}. Color white or faintly greenish, transparent and polished. Shell very delicate but faintly pitted. Shape ovoid, slightly flattened and securely glued on the flat side to the leaf.

PUPA (with long tubercles).—Length of body of the largest observed about 0.7^{mm}. Color pale yellow or pale orange. Surface of body quite coarsely rugose. Antennæ and legs faintly dusky. Eyes red, scarcely indicated above, more distinct beneath; their place above mostly occupied by a large, much elongated, somewhat tapering tubercle. Four similar tubercles of same size fringe the front margin of the head, and two still more slender tubercles rise from the middle of the head. The prothorax is furnished across its anterior and posterior margins with a row of four shorter and on its lateral margins with two longer tubercles. There is a transverse row of four similar tubercles on the meso- and metathorax: two longer, lateral ones on the meso- and one each side on the metathorax. The abdomen is furnished, medio-dorsally, with two rows of six smaller tubercles, which gradually become longer towards the end of the body, while each segment, except the last, bears a single lateral tubercle, growing gradually shorter toward the end of the body. The last segment is surrounded by four small, rounded tubercles, each bearing at tip a short spine. All tubercles appear to be slightly annulated. Antennæ long and rather stout, without annulation, with a fine, slightly capitate hair at tip, and another a little below it; thumb small, though quite distinct.

PUPA (with short tubercles).—This is the most common form. It is of about the same size, or slightly larger than the other, and

of about the same color, though the older ones are often quite orange, with the external edge of the wing-pads dusky. Eyes and ocelli red. Except a very slender, cylindrical one each side of the head, between the eyes and ocelli, all tubercles are greatly reduced in size and become quite obsolete on the abdomen in some specimens. There are no lateral tubercles, except one each side at the posterior angle of the head, one each side near posterior angle of the prothorax, and two each side on the mesothorax. Surface of body still more coarsely rugose and covered with minute, sharp points.

WINGED MIGRANT.—Length of body 0.6–0.9^{mm}. Expanse of wings 2–2.8^{mm}. Color of body yellow or orange; the prothorax generally somewhat the darkest; head of color of prothorax, with a slight dusky tinge; eyes in the younger specimens red and in the older ones dark purple; ocelli yellowish, bordered along the inner edge with red in the younger specimens and with brown in the older ones; antennæ and legs dusky; the prothorax is marked each side, anteriorly, with a sub-dorsal group of two or three more or less distinct and more or less confluent, depressed dusky spots, and with two transversely ovoid, medio-dorsal, pale dusky spots near the posterior margin; mesothorax and sternum blackish. Head and prothorax delicately rugose. Granulation of abdomen minute. Antennæ rather slender: the basal joint stoutest and longer than the second, both stoutest apically and with but faint traces of annulation; joint 3 slender and of almost uniform diameter, its sensorium rather more than two-thirds the length of the joint; annulation almost obliterated, more distinct at the basal one-third; tip furnished with three very fine, apparently capitate, hairs. Wings delicate, almost colorless. In some specimens the venation of front wings and greater part of stigma is very pale, while in others the costa, stigma, costal cell and discoidal vein are dusky, the remaining two veins delicate, often almost colorless; the stigmal vein rarely touches the stigma, but continues in a curved, very delicate, colorless line which connects it with the discoidal vein. Subcosta of posterior wings distinct, parallel with the costa and running almost to the apex of the wing.

This species has been found to infest both the upper and under side of the leaves, especially along the midrib, of *Castanea vesca*

and *pumila*, and also to some extent on the twigs of shrubs growing in the District of Columbia and in Maryland. The infested leaves frequently become very much distorted, when the ribs or veins turn brown or yellowish-brown, on account of which many of the leaves as well as numbers of the twigs dry up.

It seems rather remarkable that the majority of the immature stages of the insect, inhabiting the under side of the leaves, are of a pale yellow or almost white coloring, bearing small protuberances, whereas the majority of those on the upper side, as a rule, are bright orange and provided with long and slender tubercles. It appears, also, that one or the other form inhabits certain shrubs quite exclusively, while again both forms may occur on the leaves of others; which possibly may indicate two closely related species.

On examining the females of the two forms mentioned above I find that all those belonging to the pale form are provided with very short protuberances, which, on the abdomen, become quite rudimentary, whereas those belonging to the orange form bear long protuberances, similar to those of the pupæ. I consider, therefore, the pale or yellow form as the species described by Haldeman. Future studies, from the earlier stages to the migrant and sexes of the two forms, may reveal the presence of two related species upon *Castanea*, which may justify the adoption by me of the name of *Phylloxera spinifera* for the orange or spiny form.

PHYLLOXERA RILEYI Riley. (Licht. Mss.)

Pl. XIX., figs. 151-154.

STEM-MOTHER.—Length about 0.6^{mm}.; diameter across the thorax about 0.3^{mm}. Color dark greenish-yellow to dark brown, the protuberances almost black, the eyes dark purple or black, antennæ and legs dusky. The antennæ are long and slender and almost one-third the length of the body; the third joint is extremely slender, very slightly clavate with numerous sharply defined serrations; the sensorium small and elongated oval. The fleshy protuberances of the body are abnormally long, especially the dorsal ones, which gradually diminish in length towards the end of the body, and wanting on the last two segments; those

along the front of the head are smallest and almost ovoid, while the lateral protuberances grow gradually longer; all are covered with sharp projections or teeth, while the tip is either rounded or furnished with some short projections. The surface of the body is densely corrugated.

PUPA.—Length 0.6^{mm}. Color yellow; eyes brown; antennæ and legs dusky; the tubercles paler and the tip of the wing-pads black. Antennæ short, about one-fourth the length of the body, the third joint cylindrical and smooth. The fleshy tubercles or protuberances are very much shorter than those of the stem-mother, especially those of the abdomen which are very small and wart-like; the surface of the body is densely covered with minute points.

WINGED MIGRANTS.—Length of body 0.6^{mm}; expanse of wings about 2^{mm}. Color orange, the prothorax darkest and the abdomen palest towards the end. The prothorax is marked each side with a large, more or less triangular dusky spot, two transverse dusky stripes between them, accompanied in front by two small dots and a similar dot each side of the posterior stripe. Head dusky, eyes brown. Antennæ, thoracic lobes, sternal plate and legs black. Wings faintly dusky, veins and stigma darker, the subcosta almost black, the veins bordered by a slightly darker shade. Front of head arcuate; eyes large; abdomen much elongated and tapering. Antennæ rather short, or slightly more than one-third the length of the body; the lower sensorium of the third joint is circular or broadly oval and the upper one elongated and about one-half the length of the section above the lower sensorium; the whole joint is quite densely and sharply serrate.

Dr. C. V. Riley, in an article accompanied by figures, published in the Sixth Report on the Noxious and Beneficial Insects of Missouri, for 1874, pp. 64 and 65, and in his description of the species, p. 86, No. 25, as well as in a second article on the same in the Seventh Report for 1875, pp. 118 to 121, applied to it the name of *Phylloxera rileyi* Licht., of which specimens had previously been sent by Dr. Riley to Mr. Lichtenstein, who decided it to be a new species, to which he gave the name of *Ph. rileyi*, a name used by him, without a description, in

his observations on the economy of *Ph. vastatrix*, *quercus* and *balbianii*, in Comptes Rendus des Séances de l'Académie des Sciences, for 1875, p. 1223, and mentioned by him in the Stettiner Ent. Zeitung, p. 359, 1875. According to the above it seems to be justifiable to assume that the species was worked up in conjunction by both gentlemen, but that the species should be credited to Riley.

While consulting Dr. Riley's description of the apterous female or stem-mother of this species, p. 86, I have come to the conclusion that the description of his supposed female corresponds exactly with fig. 19, representing a female larva, specimens of which are still preserved in the original collection, whereas the mature female was described in the Seventh Report, p. 120, under the designation of "Black form with very long tubercles (c)"—where the following language is used by him: "With the body dark brown and the tubercles almost black: the dorsal ones, especially in middle of body, very long—half the diameter of body—slender, gradually tapering to tip, the lateral ones and some of the dorsal ones, less tapering and half as long. Antennæ with the third joint quite long and slender." Of this form two specimens have been preserved.

Thus far this species has been recorded as having been found only on the white oak (*Q. alba*) and the post-oak (*Q. obtusiloba*) in the vicinity of Kirkwood, Mo., on the leaves of which it produces white or yellowish circular spots; the insect, in various stages of development, often in immense numbers, is, as a rule, found on the under side of the leaves, whereas the earliest forms, as well as the sexes, frequent the branches, on which the winter eggs are deposited. The earliest migrants are usually observed during July and the latest in October. Whether the earliest migrants produce a sexual generation or not has thus far not been demonstrated, though it seems to be quite certain, since hibernating larvæ, which apparently hatched from the earliest eggs, as well as eggs, appear to have been found on the twigs.

PHYLLOXERA QUERCETI Pergande, n. sp.

Pl. XX., figs. 155-158.

APTEROUS FEMALE.—Length about 0.5^{mm}; shape pyriform, broadest about the middle of the thorax, rounded in front and

gradually tapering posteriorly. Antennæ slender, about one-third the length of the body, the third joint slightly clavate and distinctly serrate: the thumb or nipple is small and near the apex of the joint, which bears two or three short hairs. There are, apparently, six rows of very much elongated, tapering, fleshy projections which are more or less notched or toothed, bearing three or four acute lobes at the tip, on the head and thoracic segments: and four rows of similar projections on the anterior six segments of the abdomen, those of the first three segments growing gradually shorter, while those of the following three segments are very much reduced and tubercle-like; the remaining two segments bear no tubercles: on the last segment are but four small bristles. The color varies somewhat from yellow to orange and that of the eyes from dark purple to black.

The eggs deposited by the stem-mother are about 0.2^{mm} . in length and rather less in diameter; they are oval, highly polished and pale yellow, growing gradually darker by age, when a distinct sculpturing of obliquely arranged rows of hexagonal depressions makes its appearance.

The young larvæ hatched from these eggs are pale yellow, the eyes red and the antennæ, legs and warts slightly dusky. The warts are rather prominent, conical, and bear a short but stout and more or less cylindrical spine at the apex.

PUPA.—Length about 0.6^{mm} . Color yellow to orange; eyes dark purplish-brown. The fleshy projections are still longer than those of the females and more sharply toothed or serrate, the tip is more distinctly rounded and surrounded by three or four triangular teeth, while the whole surface of the body is densely covered with acute tubercles. The antennæ are about one-fourth of the length of the body, the third joint is smooth and slightly fusiform. In other respects it resembles the stem-mother.

WINGED MIGRANT.—Length of body 0.6^{mm} . to 1^{mm} . Expanse of wings 2 to 2.4^{mm} . Color orange. Mesothorax and sternal plate blackish; head, antennæ and legs dusky; eyes dark purplish: wings faintly brownish, the veins and stigma darker. There is a transverse row of four dusky, roundish swellings anteriorly and two similar swellings posteriorly on the prothorax, the

head and rest of the body without a trace of tubercles. The antennæ are about one-fourth the length of the body. The third joint is as usual in this genus, the lower sensorium rather large and more or less circular, the upper one elongated and about one-half the length of the larger or terminal section, which, below the sensorium, tapers gradually towards its base; the whole joint is quite densely and sharply serrate.

This species was found in and about the vicinity of Washington on the leaves of *Quercus alba*, *macrocarpa*, *panonia* and *daimio* from May till October, the affected leaves of which are speckled all over with small yellow spots, particularly so along the midrib and the smaller veins. The insects causing the injury are found in various stages or forms on the under side of the leaves.

It resembles to a great extent *Ph. rileyi*, though the stem-mother of that species is about twice as large, and the protuberances on all parts of its body much longer, while those of the pupæ are much smaller on the head and thorax and tubercular on the abdomen. The migratory female is almost one-half smaller, with shorter antennæ and wings.

There can scarcely be any doubt that future careful investigations will disclose the fact that several additional species will be found infesting our different kinds of oak in various sections of the country, all of them having more or less the same habits. At least five species have been discovered and described in Europe, all of which were found to inhabit various parts of oak trees.

PHYLLOXERA PROLIFERA Oestl.

Phylloxera prolifera Oestl. Synopsis of the Aphidæ of Minnesota, p. 16, 1887.

Mr. Oestlund describes this species in his synopsis as follows:

"*Apterous female*.—Color very pale (lemon-yellow, smooth, convex above, especially in front, tapering behind into a rather long ovipositor. Eyes as a very small black spot. Antennæ short and fine, 3-jointed: I. 0.05mm., II. 0.05mm., III. 0.10mm. Beak short and thick, about 0.10mm., the setæ very long when extended, at least as long as the body, brownish. Legs short; tarsi with two rather small claws, and with the two capitate hairs as usually in this genus."

"Found in the galls of *Pemphigus populicaulis* Fitch during the fall,

after the pemphigiens have left or become destroyed. Usually but one female, or at most a few, was to be found in the gall, together with a great number of pseudova in a pile that often would be several times the female in bulk."

This species I have failed to see.

PHYLLOXERA POPULARIA Pergande, n. sp.

Plate XXI., figs. 159, 160.

Large numbers of females and their eggs were discovered by Mr. E. A. Schwarz, December, 1878, in deserted galls of *Pemphigus transversus* Riley on *Populus monilifera* at Columbia, Texas, and during January of the following year at Bayou Sara, La., in similar galls and in cracks of a black knot, growing on the branches of the same tree, about forty feet above the ground. Additional specimens were received during July, 1891, from Alma, Mich., found in empty, though still green and succulent, galls of *Pemphigus populicaulis* Fitch. Other specimens, found in galls on Cottonwood in September, 1891, at Brookings, S. D., were received from Mr. T. A. Williams. During October of 1900 the same species was found by me at St. Louis, Mo., in galls of *Pemphigus transversus* Riley, which were still fresh and had but recently dropped.

APTEROUS FEMALE.—Length about 1.4^{mm}.

The young females, as found in May, are pale greenish-yellow and densely covered with minute points; antennæ and legs are pale dusky, the rostrum is black and reaches to the end of the body. The larvæ are of the color of the female, the eyes red, the rostrum dusky, extremely long and almost twice the length of the body.

Females or sexuparæ, found in October, are brownish-yellow, the eyes brown, and antennæ and legs pale dusky. Shape pyriform, the thorax stoutest and rounded; front of head more or less distinctly concave. Dorsum densely covered with minute, pointed tubercles. The rostrum reaches considerably beyond the third coxæ. Antennæ much shorter than the posterior diameter of the head; first joint much the stoutest and somewhat tapering; the second joint is much narrower, distinctly longer and clavate;

joint three is slender, about as long as the two basal joints combined, and faintly tapering; the tip is bluntly rounded and bears a few short hairs. Sensorial thumb minute, placed close to the apex of the joint. Legs normal.

SEXUAL FEMALE. — With the sexuparæ, found in galls in October, were also found numerous yellow or greenish-yellow eggs besides some sexual females, which measure about 0.2^{mm} in length. They are oval in shape and about twice as long as wide and completely filled with a single egg. Color yellow or pale greenish-yellow and sometimes dusky along each side. Antennæ short, stout, barely as long as the width of the head in front; the two basal joints are stout, about as long as broad, subequal in length and somewhat stoutest at the apex; joint three is about as long as the two basal joints combined, fusiform, with three or four shallow annulations at the terminal half. Rostrum wanting, represented by a small swelling. Legs short and stout.

On account of the food-plant and the same habit, I have hesitated to consider it different from *Ph. prolifera* Oestlund, but, since its rostrum is much longer and its body covered densely with minute points, I have concluded to consider it as different and describe it herewith as new.

In connection herewith I may mention the fact that in September of 1901 I discovered two small specimens of *Phylloxera* in the empty burrow of *Oberca* in a twig of *Populus monilifera*, from Cleveland, Ohio; whether mature or not, cannot be determined, in which the rostrum is very much longer than the body, while the dorsum is destitute of tubercles and the proportions of the antennal joints apparently different from those of the other two species. They may possibly prove distinct from either of them.

PHYLLOXERA SALICOLA Pergande, n. sp.

Plate XXI., figs. 161-168.

This and the following species (*Ph. nysææ*) are the most remarkable so far discovered in this country, and appear to be closely related to *Ph. popularia* Pergande and *Ph. prolifera* Oestl. and *Ph. salicis* Licht., of none of which the winged or migratory form has yet been observed, though it doubtless exists. The present species

infests not alone the stems and twigs of willows but occasionally also the under side of the leaves. Those on the wood are always stationed in some crack, under the delicate loose bark, or are pushed in between the leaf-buds and the twig. All are completely covered with a white wooly secretion which hides the insect from view and recalls in appearance certain coccids of the genera *Pseudococcus* and *Dactylopius*.

PUPIFEROUS FEMALE.—Length 0.6–0.9^{mm}. Shape of younger, most vigorous specimens, elongate-pyriform, and that of the old or almost empty ones quite circular. Color yellow, the older ones brownish-yellow, with head and thorax darkest. Antennæ and legs faintly dusky. Eyes brown or blackish. Rostrum very long, reaching almost to the end of the body. Antennæ rather slender: joint 2 longer and more slender than the first, both stoutest near the apex; joint 3 longer than the two basal ones combined, of uniform diameter or faintly stoutest near base and slightly curved; thumb extremely minute and placed close to apex; annulation almost imperceptible, the tip apparently provided with two minute hairs. Surface of the body covered quite densely with minute and somewhat pointed granules. In addition to the general granulation there appear to be six rows of secretary spots or warts on the abdomen, less numerous on the head and thoracic segments, all of which are detected with much difficulty. Each of these warts is again divided into four to six groups, which are composed of three to four still smaller divisions or pores. Four short hairs fringe the front of the head, two similar ones each side the thoracic and one each side of the abdominal segments.

SEXUAL EGGS.—Length of egg producing the female about 0.2^{mm}; that producing the male somewhat smaller, the former regularly ovoid, the latter somewhat pointed posteriorly. Color yellow, highly polished, and without sculpturing.

MALE AND FEMALE.—Length of female scarcely 0.3^{mm}, the male being about one-fourth less. Color of both pale yellow, though the male is slightly darkest. Antennæ and legs faintly dusky, darkest in the male. Eyes reddish or brown. Antennæ extremely small and very similar in both sexes: joint 1 stoutest and largest; joint 2 very short, sometimes scarcely noticeable; joint 3 scarcely

longer than the first, in the male being sometimes almost globular; the thumb is minute and placed near the apex. There are faint indications of three or four annulations, and the tip is provided with two minute hairs. Surface of body minutely granulate; besides the granulation there are, on each side of the thorax of the female, three more or less prominent lateral tubercles. Rostrum rudimentary.

With each of the pupiferous females were found from one to eight eggs, most of them sexual though occasionally a few smaller ones, which produced non-sexual larvæ, with a long and well-developed rostrum. This may possibly produce a migratory generation the following season. These larvæ are scarcely 0.2^{mm} in length, with the rostrum extending beyond the tip of the abdomen. Color yellow; eyes brown; antennæ, legs and rostrum pale dusky. Surface of body similarly granulated to that of the parent. Antennæ rather long and slender, reaching to base of first pair of legs; joint 1 shortest and stoutest, narrowest at apex; joint 2 considerably longer, more slender and stoutest near the end; joint three 3 nearly twice the length of the other two combined, very slender and of uniform diameter, with two fine hairs at tip; thumb minute, though quite distinct.

The species was found during September on some small shrubs of either *Salix discolor* or *humilis* (species not determinable without the flowers), growing in a swampy spot in the middle of a piece of woods in the District of Columbia, with no other willows within a radius of a mile or more.

PHYLLOXERA NYSSÆ Pergande, n. sp.

Plate XXI., figs. 169-174.

This species, like the preceding one, is equally remarkable on account of the white secretion which covers it completely, giving it a decided resemblance to *Pseudococcus*. It is much larger and stouter than *Ph. salicicola*, with the antennæ of the pupiferous female shorter and those of the sexes longer than in that species.

PUPIFEROUS FEMALE.—Length 1-1.3^{mm}. Shape broadly ovoid; broadest across the thorax. Surface of body densely covered with extremely minute points. Color lemon-yellow. Eyes red, minute.

more distinct beneath than above. Legs short and stout. Rostrum short, reaching to the second coxæ in older specimens and to the abdomen in the younger ones; pale brown at base, with the rest pale dusky. Antennæ short and stout; joint 1 much the stoutest and truncate at tip; joint 2 somewhat longer, clavate; joint 3 a little longer than the two basal joints combined, faintly curved, its surface rather indistinctly and sparsely annulate, and bearing apparently three minute hairs at tip; thumb very small.

SEXUAL EGGS.—Yellow, apparently highly polished, and of the normal form.

MALE AND FEMALE.—Length of the male about 0.3^{mm} . and of the female 0.4^{mm} . Surface of body covered with minute points. Color pale yellow; eyes reddish and more prominent beneath than above. Antennæ and legs with a faintly dusky tinge, darkest in the male. Antennæ very short; the two basal joints about equal in length, the first much the stoutest. In the female the second joint appears to be a little longer than the first and slightly clavate; joint 3 is about as long as the two basal joints combined, stoutest at the apical third, with five or six faint annulations, and provided at tip with two or three minute hairs; the thumb is scarcely noticeable. Legs stout, longer in the male. Rostrum rudimentary.

This species was found by me during September in the middle of the woods in the same locality as *Ph. salicicola*, on the trunks of young trees of *Ayssa sylvatica*, in cracks and depressions of the bark, though more particularly in the cavities caused by the dropping out of small dead twigs, about five or six feet above the ground. It is difficult to discover and appears to be quite rare. None could be found, after much search, on the trunks of larger trees.

The types of the new species described in this paper, as well as those described by the late Dr. C. V. Riley, and also co-types of most of the species described by Dr. Asa Fitch, Dr. Henry Shimer, and Mr. Benjamin D. Walsh, are preserved in the collection of the U. S. Department of Agriculture.

Phylloxera vastatrix Planchon has been purposely omitted from this paper on account of the large amount of literature pertaining

to the life history of this insect, and the economic relations of the species to the cultivated and wild varieties of grape-vines.

Excellent descriptions and illustrations of it may be found in Dr. C. V. Riley's Sixth Report on the Noxious and Beneficial Insects of Missouri for 1871, pp. 30-86.

ERRATA.

Page 217, line 21, from above, read *Ph. globosa*.

Page 236, bottom line, read 393.

Page 236, line 3, from bottom, read 1867, p. 2.

Page 236, line 6, from bottom, read *globosa*.

Page 247, line 15, from above, read *spinuloides*.

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Species inhabiting hickory trees.

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In the reproduction of the plates the original size has been in all cases slightly reduced. This must distinctly be borne in mind when comparing the plates with the explanations.]

EXPLANATION OF PLATES.

PLATE I.

Phylloxera c.-septum (Shimer).

- Fig. 1. Young galls, above and beneath—natural size.
- Fig. 2. Young gall, side view—greatly enlarged.
- Fig. 3. Young galls, above and beneath—farther advanced.
- Fig. 4. Mature galls, above and beneath—natural size.
- Fig. 5. Mature galls, above and beneath—natural size.
- Fig. 6. Mature gall, vertical section—greatly enlarged.

Phylloxera perforans Pergande, var :

- Fig. 7. Mature galls—natural size.
- Fig. 8. Mature gall, vertical section—greatly enlarged.

PLATE 1

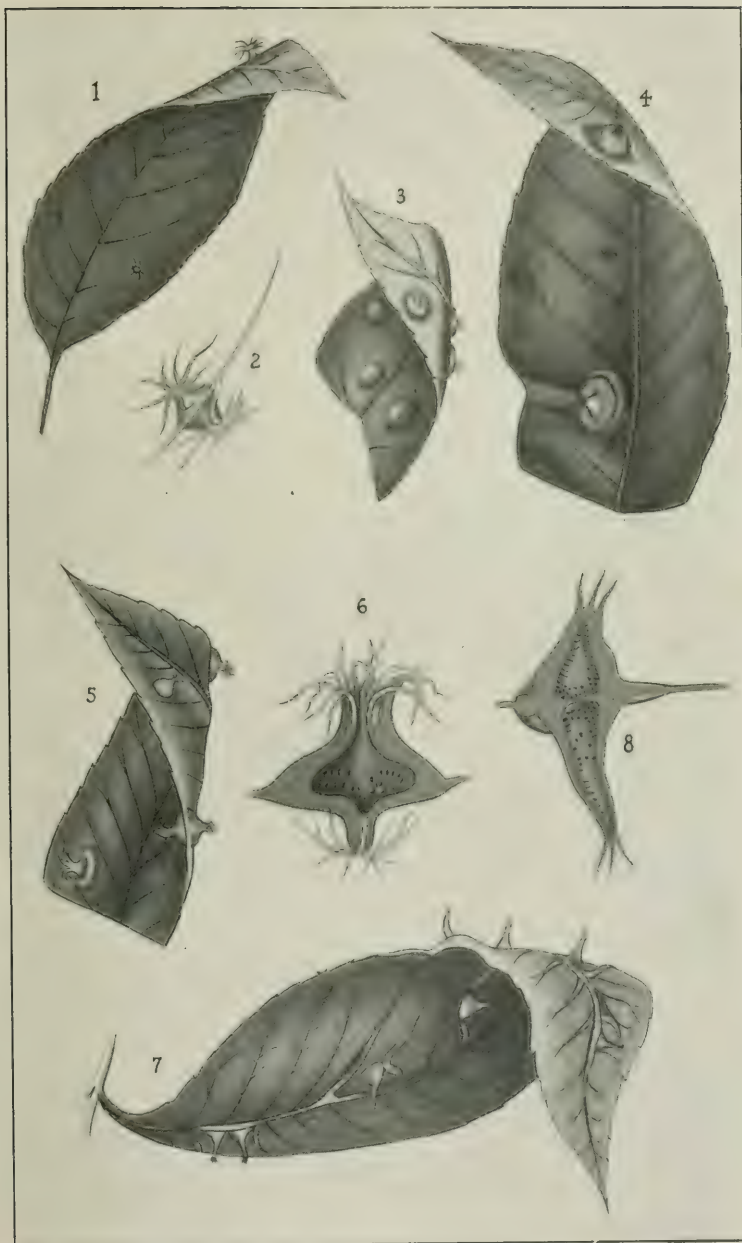


PLATE II.

Phylloxera c.-foliæ Fitch.

Fig. 9. Mature galls, above and beneath—natural size.

Phylloxera picta Pergande, n. sp.

Fig. 10. Mature galls, above and beneath—natural size.

Phylloxera intermedia Pergande, n. sp.

Fig. 11. Mature galls, above and beneath—natural size.

Fig. 12. Mature gall, vertical section—greatly enlarged.

Fig. 13. Mature galls, above and beneath—natural size.

Fig. 14. Mature gall, vertical section—greatly enlarged.

PLATE II

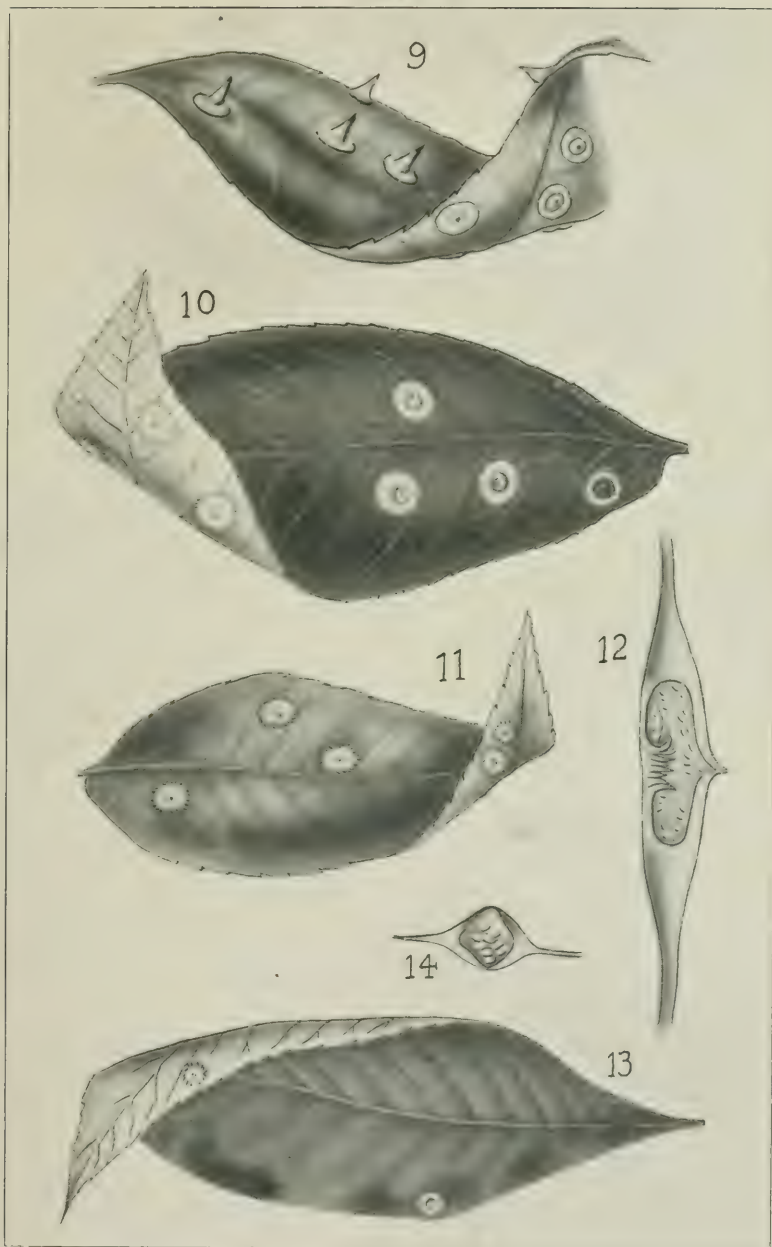


PLATE III.

Phylloxera foveola Pergande, n. sp.

- Fig. 15. Mature galls—natural size.
Fig. 16. Mature gall, vertical section enlarged.

Phylloxera pilosula Pergande, n. sp.

- Fig. 17. Mature galls, above and beneath—natural size.

Phylloxera deplanata Pergande, n. sp.

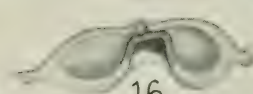
- Fig. 18. Young galls, above and beneath—natural size.
Fig. 19. Young gall, from beneath—much enlarged.
Fig. 20. Young gall, from above—much enlarged.

PLATE III

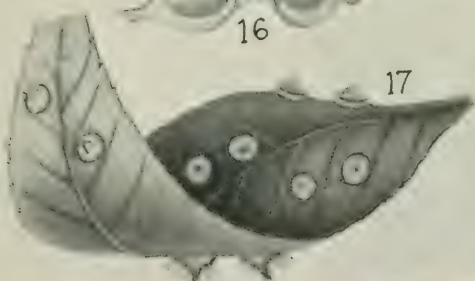
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PLATE IV.

Phylloxera deplanata Pergande, n. sp.

- Fig. 21. Mature galls, above and beneath—natural size.
Fig. 22. Mature galls, above and beneath—natural size.
Fig. 23. Mature gall, vertical section—much enlarged.

Phylloxera rimosalis Pergande, n. sp.

- Fig. 24. Mature galls, above and beneath—natural size.

Phylloxera c.-scissa Riley.

- Fig. 25. Mature galls, above and beneath—natural size.

PLATE IV

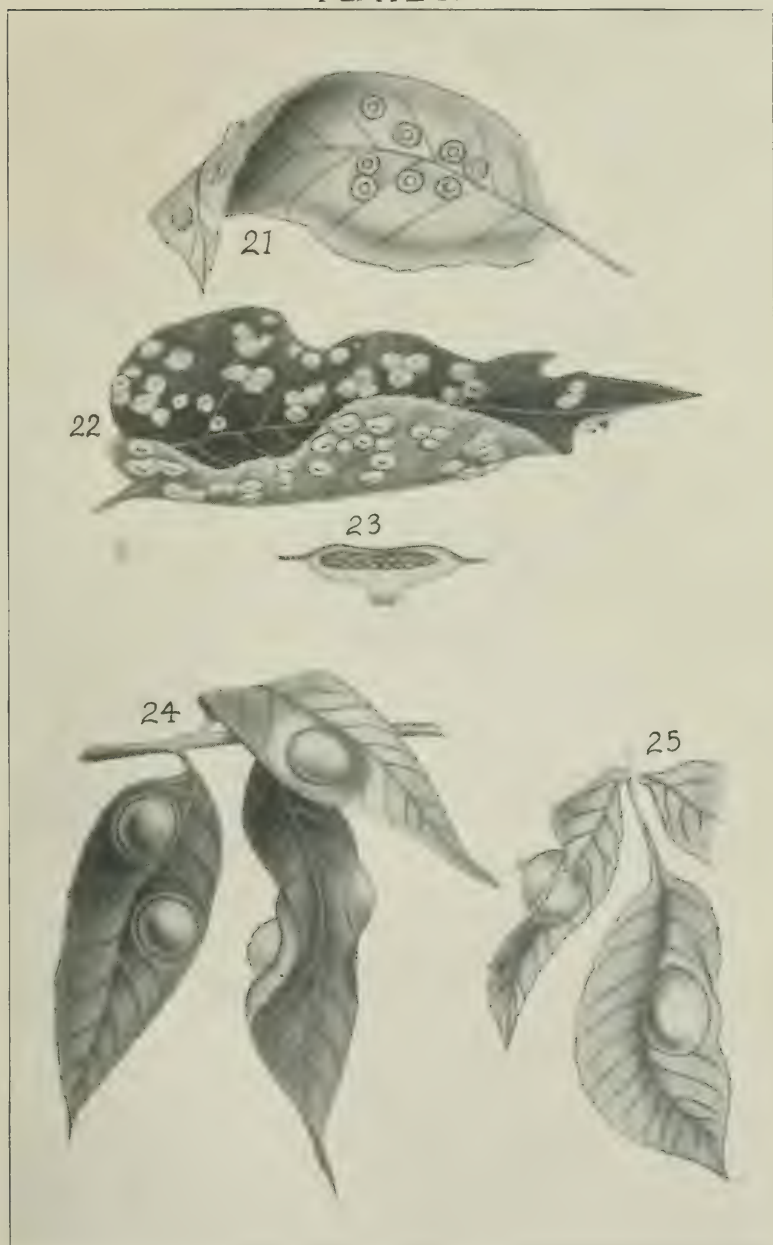


PLATE V.

Phylloxera conica (Shimer).

- Fig. 26. Young galls, above and beneath—natural size.
- Fig. 27. Young gall, vertical section—enlarged.
- Fig. 28. Mature galls, above and beneath—natural size.
- Fig. 29. Mature galls, variety ; above and beneath—natural size.

Phylloxera c.-avellana Riley.

- Fig. 30. Young galls, above and beneath—natural size.
- Fig. 31. Mature galls, above and beneath—natural size.

PLATE V



PLATE VI.

Phylloxera c.-avellana Riley.

- Fig. 32. Mature galls, from beneath—natural size.
- Fig. 33. Mature gall, vertical section—much enlarged.
- Fig. 34. Mature galls, variety—natural size.
- Fig. 35. Mature galls, variety ; above and beneath—natural size.
- Fig. 36. Mature gall, variety ; vertical section—much enlarged.

Phylloxera c.-gummosa Riley.

- Fig. 37. Mature gall—reduced $\frac{1}{3}$.

Phylloxera c.-venæ Fitch.

- Fig. 38. Mature galls, from above—natural size.
- Fig. 39. Mature galls, from beneath—greatly enlarged.

PLATE VI

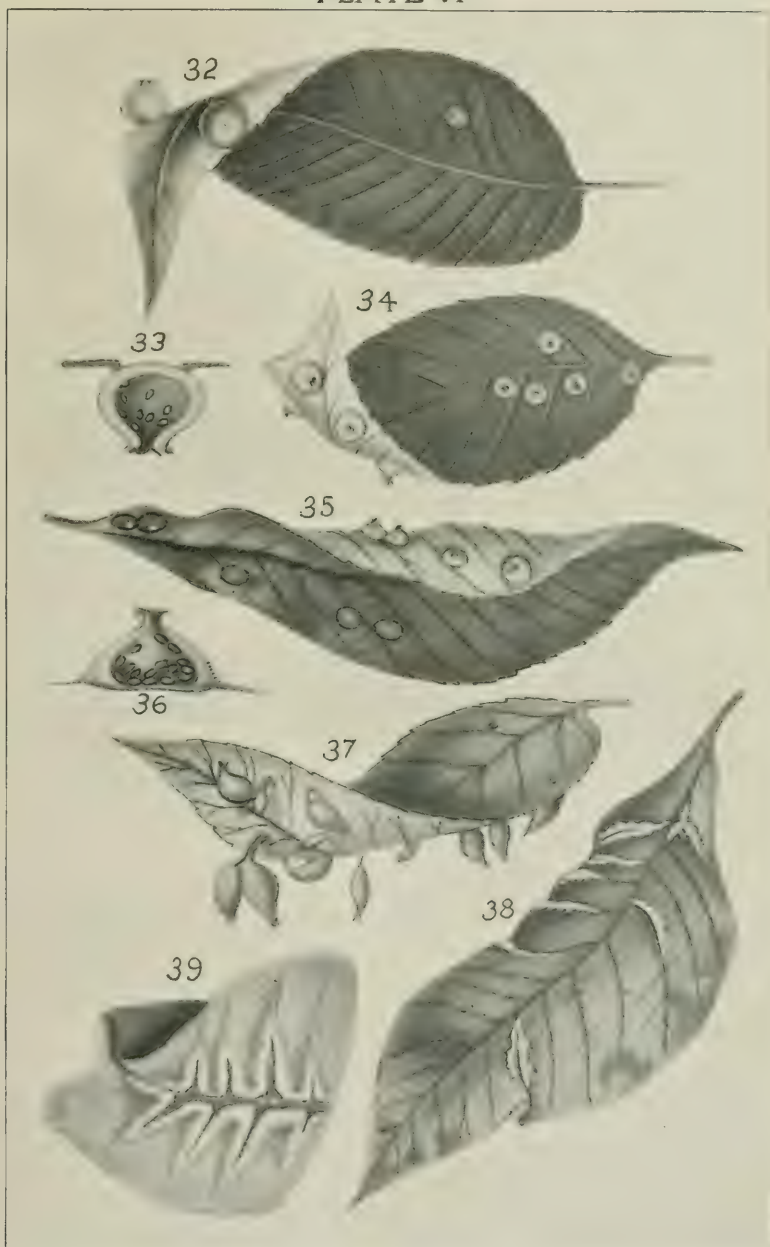


PLATE VII.

Phylloxera c.-caulis Fitch.

Fig. 40. Mature galls, typical form—natural size.

Phylloxera c.-magnum Shimer, var.:

Fig. 41. Mature galls—natural size.

Fig. 42. Mature galls—natural size.

PLATE VII



PLATE VIII.

Phylloxera spinosum Shimer, var.:

Fig. 43. Young galls—immature.

Fig. 44. Mature gall—natural size.

Phylloxera perniciosa Pergande, n. sp.

Fig. 45. Mature galls—natural size.

PLATE VIII

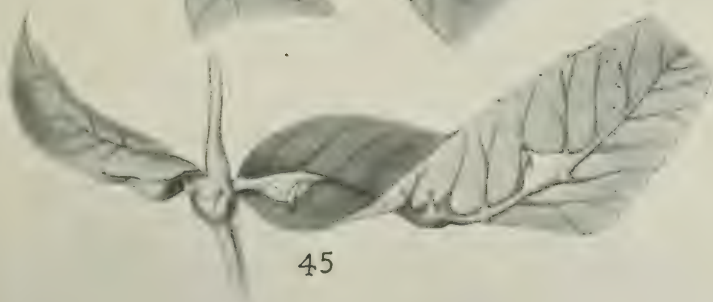


PLATE IX.

Phylloxera c.-septum (Shimer).

Fig. 46. Mature gall, vertical section—enlarged.

Phylloxera c-foliæ Fitch.

Fig. 47. Mature gall, vertical section—enlarged.

Phylloxera picta Pergande, n. sp.

Fig. 48. Mature gall, vertical section—enlarged.

Phylloxera pilosula Pergande, n. sp.

Fig. 49. Mature gall, vertical section—enlarged.

Phylloxera c-semen Walsh.

Fig. 50. Mature galls, above and beneath—natural size.

Fig. 51. Mature gall, vertical section—enlarged.

Phylloxera c.-fallax Walsh.

Fig. 52. Mature galls, above and beneath—natural size.

Fig. 53. Mature gall, vertical section—enlarged.

Phylloxera rimosalis Pergande, n. sp.

Fig. 54. Mature gall, vertical section—enlarged.

Phylloxera c.-scissa Riley.

Fig. 55. Mature gall, vertical section—enlarged.

Fig. 56. Mature gall, showing transverse slit—natural size.

PLATE IX

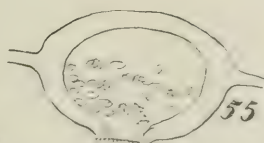
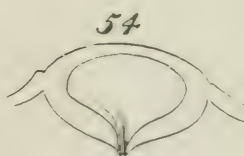
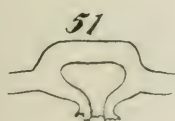
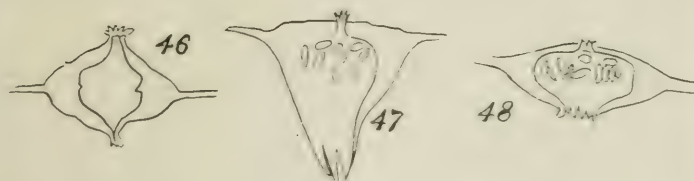


PLATE X.

Phylloxera perforans Pergande, var.:

- Fig. 57. Stem-mother—enlarged 40 diameters.
- Fig. 58. Antenna of stem-mother—enlarged 250 diameters.
- Fig. 59. Egg of stem-mother—greatly enlarged.
- Fig. 60. Antenna of migratory female—enlarged 250 diameters

Phylloxera bicta Pergande, n. sp.

- Fig. 61. Stem-mother—enlarged 40 diameters.
- Fig. 62. Antenna of stem-mother—enlarged 250 diameters.
- Fig. 63. Antenna of migratory female—enlarged 250 diameters.

Phylloxera intermedia Pergande, n. sp.

- Fig. 64. Migratory female—enlarged 40 diameters.
- Fig. 65. Antenna of migratory female—enlarged 250 diameters.

Phylloxera deplanata Pergande, n. sp.

- Fig. 66. Stem-mother—enlarged 40 diameters.
- Fig. 67. Antenna of stem-mother—enlarged 250 diameters.
- Fig. 68. Sexual Female—enlarged 80 diameters.
- Fig. 69. Male—enlarged 80 diameters.
- Fig. 70. Antenna of sexual female—enlarged 250 diameters.

PLATE X

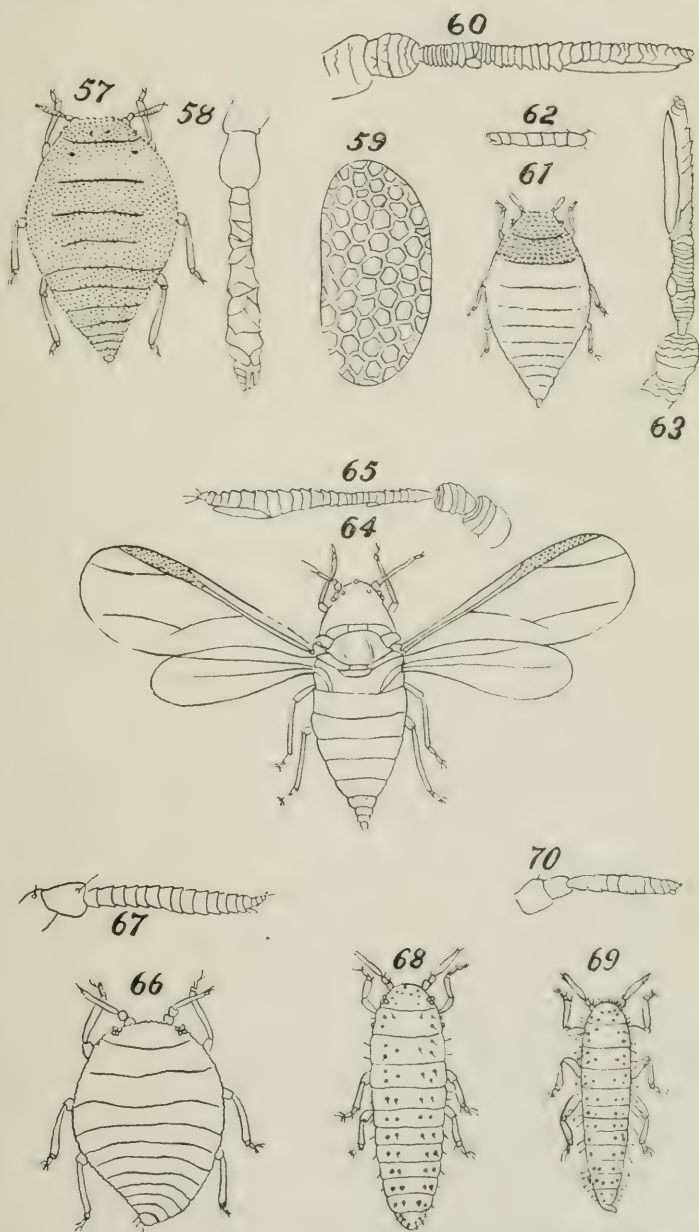


PLATE XI.

Phylloxera c.-fallax Walsh.

- Fig. 71. Migratory female—enlarged 40 diameters.
- Fig. 72. Antenna of migratory female—enlarged 250 diameters.
- Fig. 73. Male—enlarged 40 diameters.
- Fig. 74. Antenna of male—enlarged 250 diameters.

Phylloxera conicum (Shimer).

- Fig. 75. Stem-mother—enlarged 40 diameters.
- Fig. 76. Antenna of stem-mother—enlarged 250 diameters.
- Fig. 77. Antenna of migratory female—enlarged 250 diameters.
- Fig. 78. Mature gall, vertical section—much enlarged.

Phylloxera c.-avellana Riley

- Fig. 79. Migratory female—enlarged 40 diameters.
- Fig. 80. Antenna of migratory female—enlarged 250 diameters.
- Fig. 81. Mature gall, vertical section—much enlarged.

PLATE XI

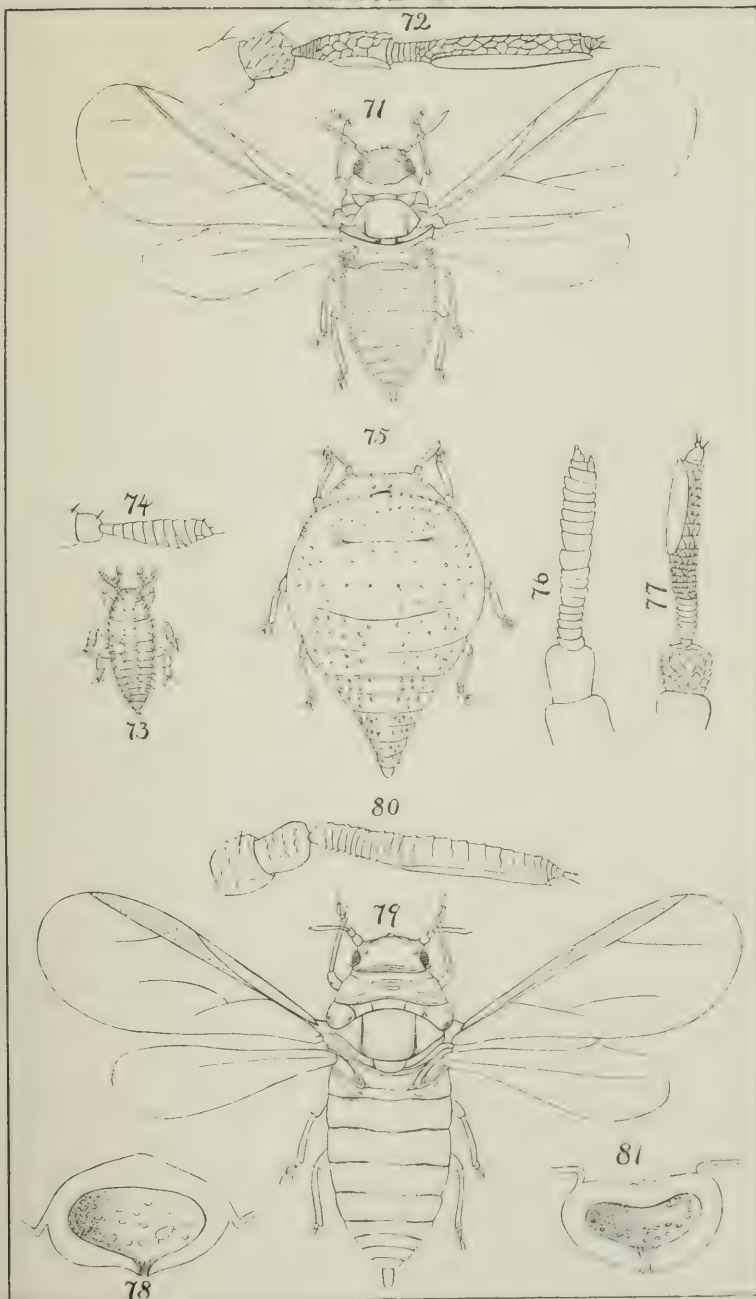


PLATE XII.

Phylloxera notabilis Pergande, n. sp.

- Fig. 82. Immature galls, from beneath—natural size.
- Fig. 83. Immature gall, vertical section—much enlarged.
- Fig. 84. Mature galls, from above—natural size.
- Fig. 85. Mature gall, lateral view—enlarged.
- Fig. 86. Stem-mother—much enlarged.
- Fig. 87. Sexupar pupa—much enlarged.
- Fig. 88. Antenna of sexupar pupa—much enlarged.
- Fig. 89. Migratory female—much enlarged.
- Fig. 90. Antenna of migratory female—much enlarged.

PLATE XII

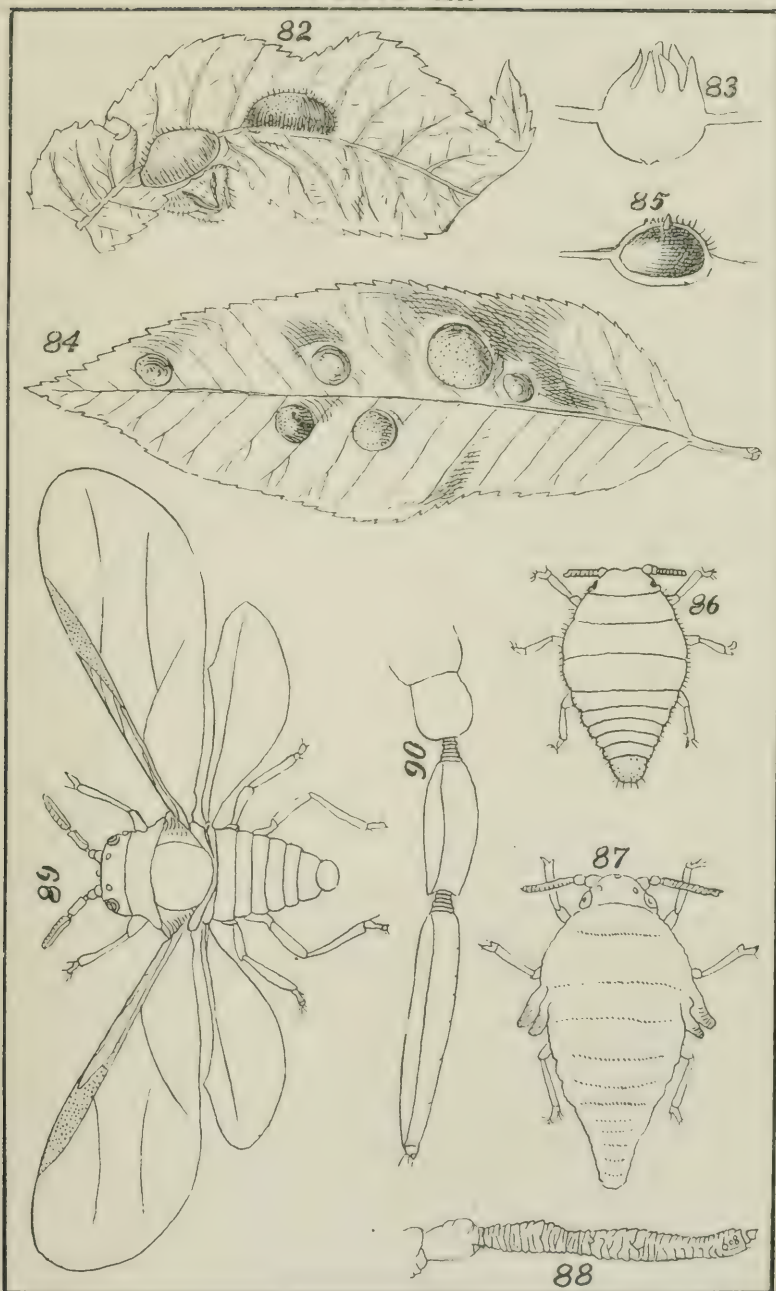


PLATE XIII.

Phylloxera c.-globosum Shimer.

- Fig. 91. Mature galls, above and beneath—natural size.
Fig. 92. Mature gall, vertical section—much enlarged.

Phylloxera c.-coniferum Shimer.

- Fig. 93. Mature galls, above and beneath—reduced $\frac{1}{3}$.
Fig. 94. Mature gall, vertical section—enlarged.

Phylloxera c.-gummosa Riley.

- Fig. 95. Mature gall, vertical section—much enlarged.
Fig. 96. Stem-mother—magnified 40 diameters.
Fig. 97. Antenna of stem-mother—magnified 250 diameters.

Phylloxera c.-venæ Fitch.

- Fig. 98. Stem-mother—magnified 40 diameters.
Fig. 99. Antenna of stem-mother—enlarged 250 diameters.
Fig. 100. Winter-egg—magnified 120 diameters.
Fig. 101. Apterous sexupare, ventral view—magnified 40 diameters.
Fig. 102. Apterous sexupare, dorsal view—magnified 40 diameters.
Fig. 103. Apterous sexupare, antenna—magnified 250 diameters.
Fig. 104. Sexual female—magnified 200 diameters.
Fig. 105. Sexual female, antenna—magnified 500 diameters.

PLATE XIII

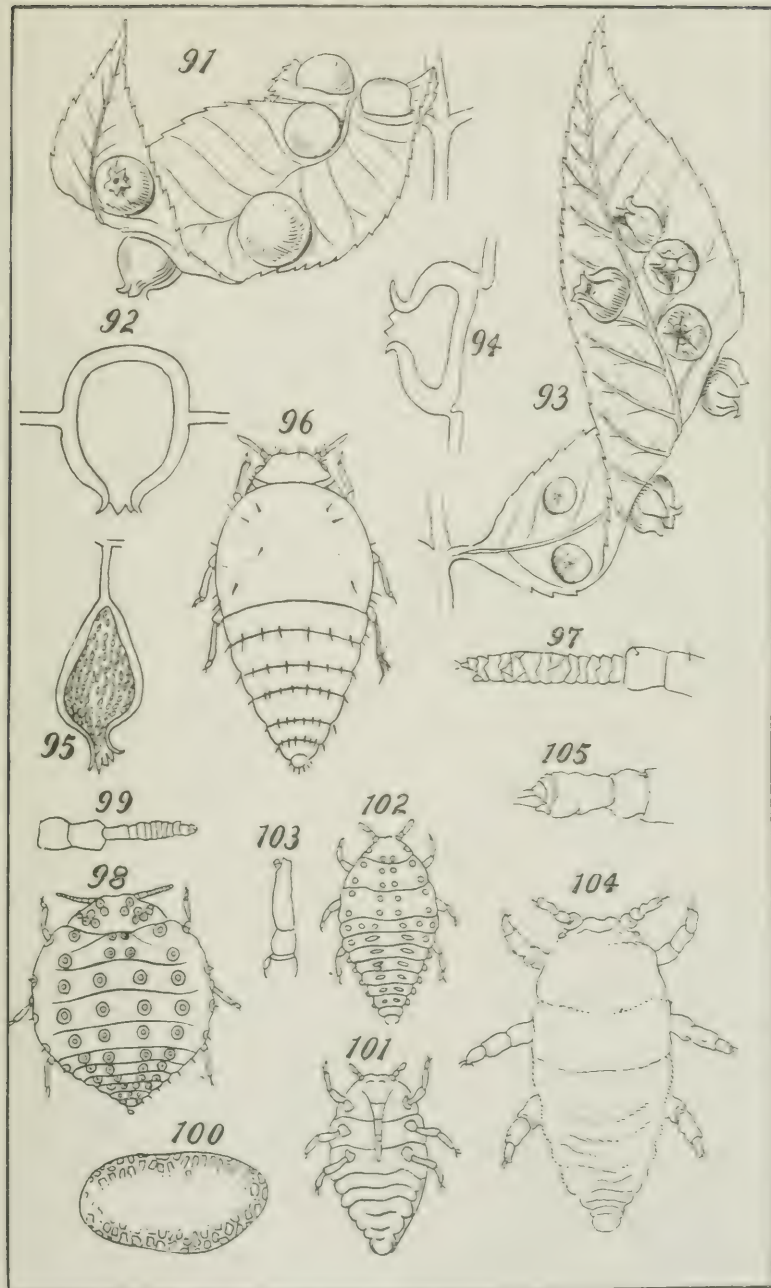


PLATE XIV.

Phylloxera c.-caulis Fitch.

Fig. 106. Old galls of various forms—natural size.

Phylloxera c.-magnum Shimer, var.:

Fig. 107. Mature gall, vertical section—enlarged.

Phylloxera c.-spinosum Shimer.

Fig. 108. Young galls—reduced $\frac{1}{3}$.

Fig. 109. Young gall, vertical section—enlarged.

Fig. 110. Mature gall, transverse section with arrangement of pupæ—natural size.

Fig. 111. Arrangement of pupæ—much enlarged.

Fig. 112. Variety of old galls—reduced $\frac{1}{3}$.

Fig. 113. Variety of old galls—natural size.

Fig. 114. Variety of old galls, transverse section—enlarged.

PLATE XIV

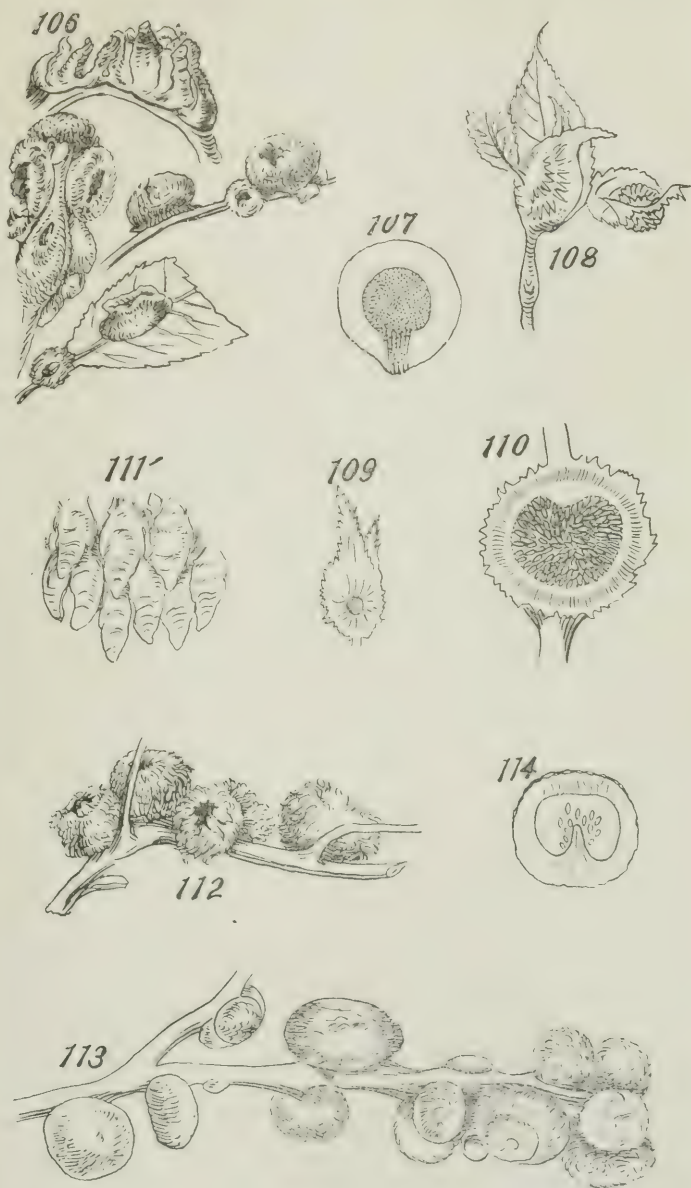


PLATE XV.

Phylloxera georgiana Pergande, n. sp.

- Fig. 115. Mature galls; alcoholic—natural size.
Fig. 116. Mature gall, vertical section—much enlarged.
Fig. 117. Antenna of migratory female—magnified 250 diameters.

Phylloxera subellipticum Shimer.

- Fig. 118. Immature gall—reduced $\frac{1}{3}$.
Fig. 119. Vertical section—reduced $\frac{1}{3}$.

*Phylloxera pernicios*a Pergande, n. sp.

- Fig. 120. Young galls on petiole, showing interior of gall—enlarged.
Fig. 121. Young gall, vertical section—much enlarged.
Fig. 122. Mature galls—reduced $\frac{1}{3}$.
Fig. 123. Mature gall, vertical section—much enlarged.

PLATE XV

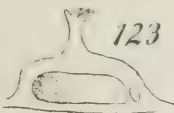
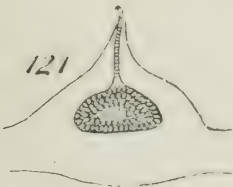
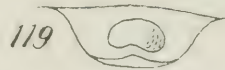
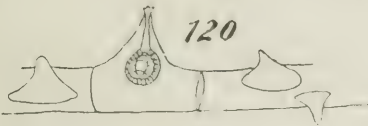
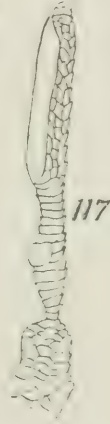
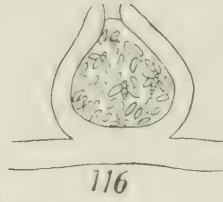
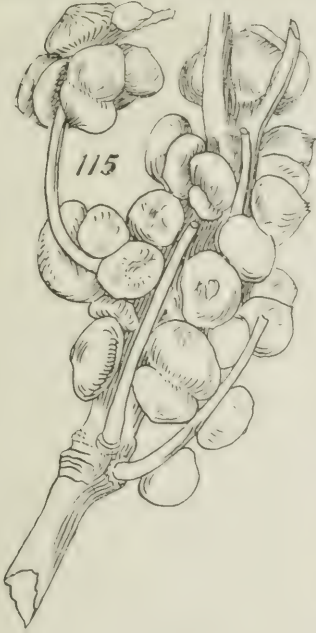


PLATE XVI.

Phylloxera spinosum Shimer

- Fig. 124. Migratory female—magnified 40 diameters.
Fig. 125. Antenna of migratory female—magnified 250 diameters.
Fig. 126. Stem-mother—magnified 40 diameters.
Fig. 127. Antenna of stem-mother—magnified 250 diameters.

PLATE XVI

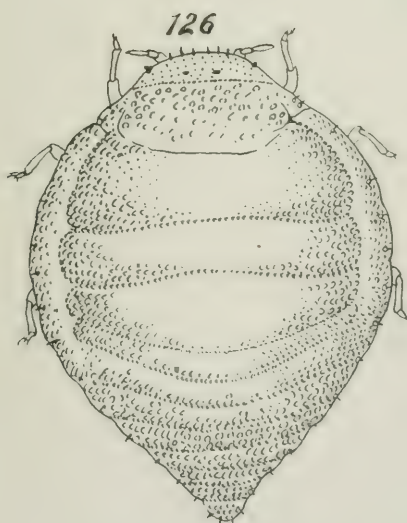
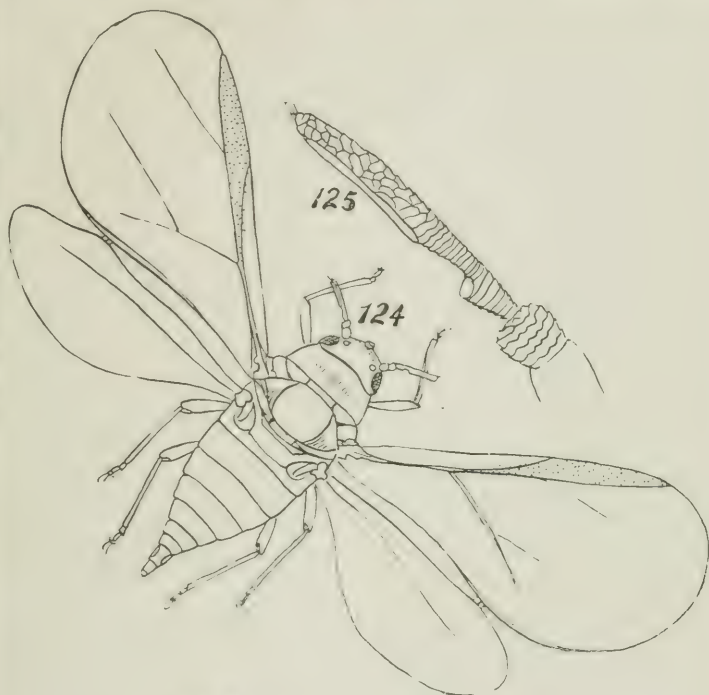


PLATE XVII.

Phylloxera spinuloida Pergande, n. sp.

- Fig. 128. Mature gall—reduced $\frac{1}{3}$.
Fig. 129. Migratory female—magnified 40 diameters.
Fig. 130. Antenna of migratory female—magnified 250 diameters.

Phylloxera devastatrix Pergande, n. sp.

- Fig. 131. Young galls in various stages, showing deformation of flowers—
reduced $\frac{1}{3}$.
Fig. 132. Young galls, different stages—reduced $\frac{1}{3}$.
Fig. 133. Mature galls—reduced $\frac{1}{3}$.
Fig. 134. Old galls—reduced $\frac{1}{3}$.
Fig. 135. Antenna of migratory female—magnified 250 diameters.

PLATE XVII

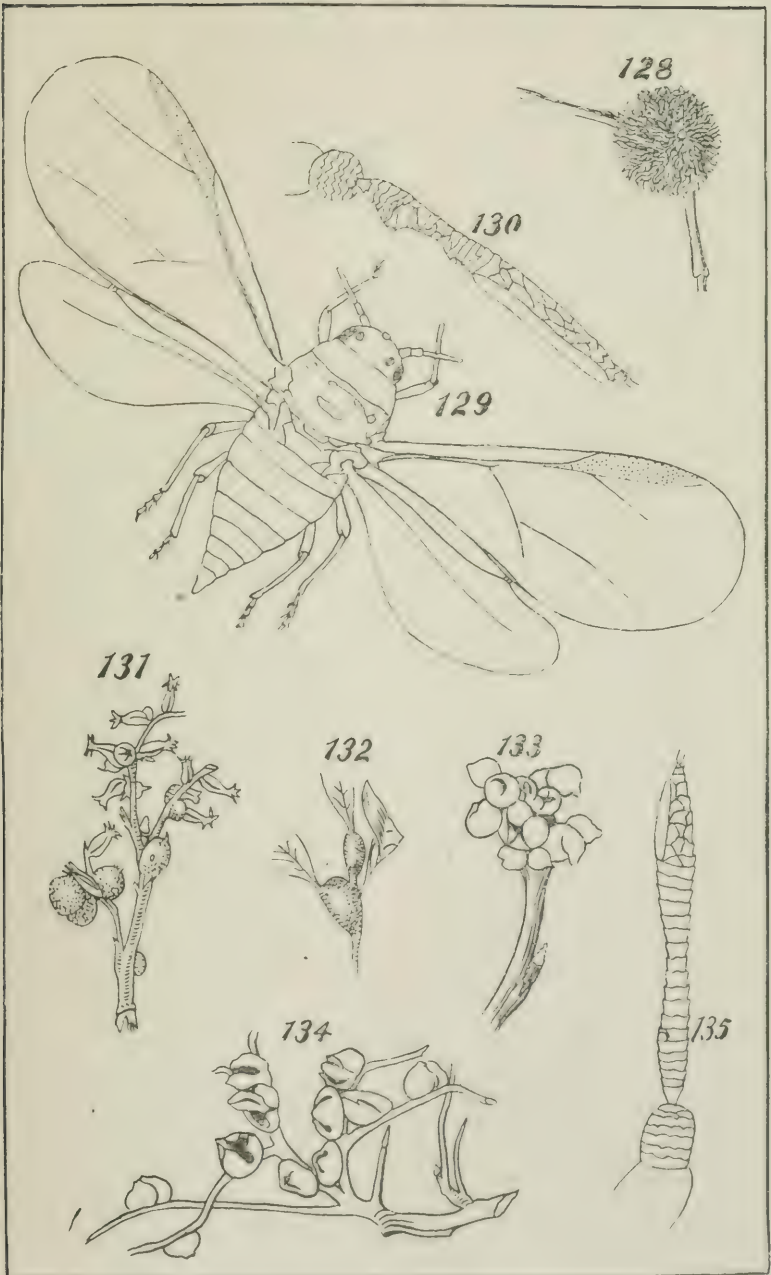


PLATE XVIII.

*Phylloxera pernicios*a Pergande, n. sp.

- Fig. 136. Mature galls, on blossoms—reduced $\frac{1}{3}$.
Fig. 137. Young stem-mother, after hatching—magnified 300 times.
Fig. 138. Antenna of young stem-mother—magnified about 500 times.
Fig. 139. Tibia and tarsus of same—highly magnified.
Figs. 140-141. Antennæ of migratory female, showing range of variation
—magnified 250 diameters.

Phylloxera c-ren Riley.

- Fig. 142. Mature galls—reduced $\frac{1}{3}$.

*Phylloxera castane*a Haldeman.

- Fig. 143. Apterous female—magnified 40 diameters.
Fig. 144. Antenna of apterous female—magnified 250 diameters.
Fig. 145. Pupa, with short tubercles—magnified 40 diameters.
Fig. 146. Antenna of same—magnified 250 diameters.
Fig. 147. Pupa, with long tubercles—magnified 40 diameters.
Fig. 148. Antenna of same—magnified 250 diameters.
Fig. 149. Migratory female—magnified 40 diameters.
Fig. 150. Antenna of migratory female—magnified 250 diameters.

PLATE XVIII

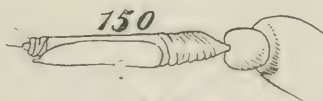
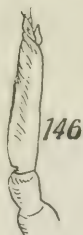
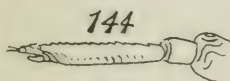
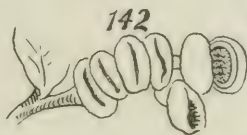
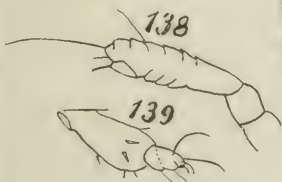
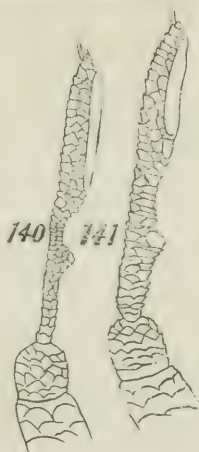
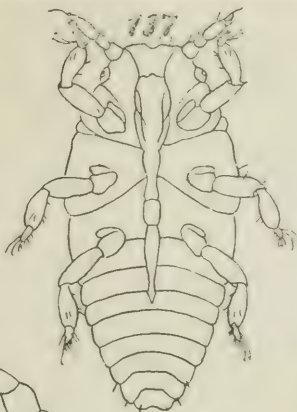


PLATE XIX.

Phylloxera villosa Riley.

Fig. 151. Apterous female—much enlarged.

Fig. 152. Pupa—much enlarged.

Fig. 153. Migrant—much enlarged.

Fig. 154. Antenna of migrant—greatly enlarged.

PLATE XIX

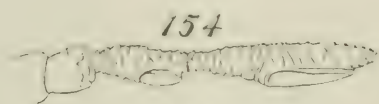


PLATE XX.

Phylloxera querceti Pergande, n. sp.

- Fig. 155. Apterous female—much enlarged.
Fig. 156. Pupa—much enlarged.
Fig. 157. Protuberance of pupa—greatly enlarged.
Fig. 158. Migrant—much enlarged.

PLATE XX

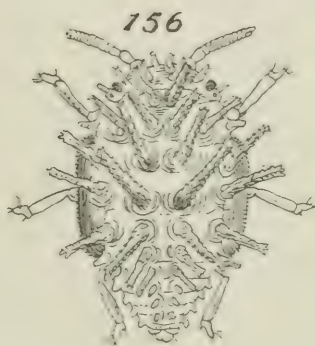
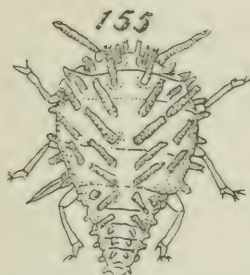


PLATE XXI.

Phylloxera popularis Pergande, n. sp.

- Fig. 159. Apterous female—magnified 40 diameters.
Fig. 160. Antenna of same—magnified 250 diameters.

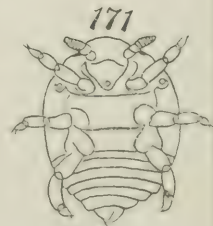
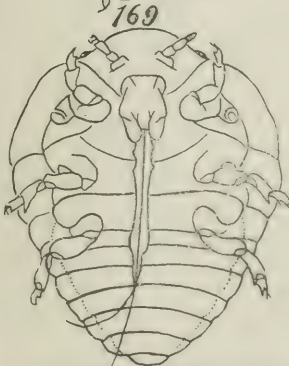
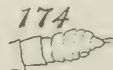
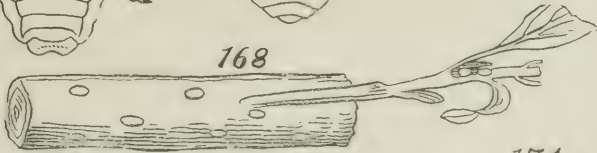
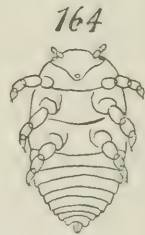
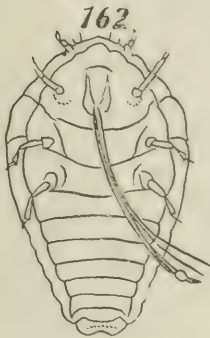
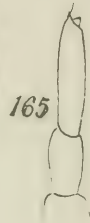
Phylloxera salicicola Pergande, n. sp.

- Fig. 161. Pupiferous female, dorsal view—magnified 30 diameters.
Fig. 162. Pupiferous female, ventral view—magnified 30 diameters.
Fig. 163. Sexual female, ventral view—magnified 100 diameters.
Fig. 164. Male, ventral view—magnified 100 diameters.
Fig. 165. Antenna of pupiferous female—magnified 250 diameters.
Fig. 166. Tip of antenna of pupiferous female—magnified 400 diameters.
Fig. 167. Antenna of sexes—magnified 400 diameters.
Fig. 168. Pupiferous females in position—natural size.

Phylloxera nyssæ Pergande, n. sp.

- Fig. 169. Pupiferous female, ventral view—magnified 50 diameters.
Fig. 170. Sexual female, ventral view—magnified 50 diameters.
Fig. 171. Male, ventral view—magnified 50 diameters.
Fig. 172. Antenna of pupiferous female—magnified 150 diameters.
Fig. 173. Antenna of sexual female—magnified 150 diameters.
Fig. 174. Antenna of male—magnified 150 diameters.

PLATE XXI



SYNOPSIS OF PROCEEDINGS
OF THE
Davenport Academy of Sciences
1901—1903.

January 26, 1901.—ANNUAL MEETING.

Edward S. Hammatt in the chair; eight members present.
Reports of officers:

REPORT OF THE PRESIDENT.

The work of the Academy the past year has been devoted to putting its old and new buildings in such a shape as to preserve them and make them useful for the future. The expense, as is usually the case, has exceeded the amount expected. The work has been done in the most permanent form possible, and anyone going carefully through the buildings will see how important every item of expenditure has been. A brief history of the work is as follows:

The donation, through Bishop Morrison, of the museum and scientific books of Griswold College, necessitated the preparation of a room for their reception. It was decided to clean and paper the basement room of Science Hall for the collection.

Realizing that the two buildings must be connected to be of any practical use, the Trustees, after a careful examination of Science Hall, which was found to be substantially built and well fitted for the present needs of the Academy, decided to make more permanent improvements. A two-story brick building, 15x30 feet, was constructed, connecting the two buildings, and forming spacious and well-lighted rooms, admirably suited for museum purposes, and leading very conveniently to the lecture hall and annex museum.

Science Hall has been refrescoed and makes a serviceable lecture hall. It is hoped that, as the citizens appreciate the advantages of this hall, from its use will come one of the revenues of the

Academy. A granitoid walk has been laid around the corner property, and the draining and perfect repairs of both buildings insure permanency. Science Hall has been repainted outside, making it an attractive building.

I also feel that the Academy owes a debt of gratitude to Mr. A. F. Cutter for his efficient and faithful superintendency of this work, and would suggest that the Academy, as a token of appreciation, elect him a life member.

We have had a few informal talks at our regular meetings, and the dedication of Science Hall on December 14 was an event of importance. President MacLean and Professor Nutting of the State University of Iowa, and Professor Starr of the University of Chicago, were present and made addresses. Cordial letters have been received from scientific friends all over the country, congratulating the Academy on its well-earned success.

We feel now that the Academy has more room for museum purposes and greater opportunity for growth.

Efficient work has been done during the holidays by Mr. Paarmann, a Davenport student at the State University of Iowa. He arranged the collections of Corals, Echinoderms and Crustacea, hoping to continue his work at the Easter vacation.

The library was in such confusion that it was practically useless. An opportunity was had of employing two graduates of the library course at Ames at very low salaries. Though there was much other work pressing to be done, it seemed best to avail ourselves of this opportunity. The library has been catalogued and put in order and many sets of books made complete by writing for missing numbers. The whole has been done for less than \$400.

I most earnestly hope that this next year will see a closer relation between the Academy and the educational institutions in and around Davenport. More and more are the advantages of teaching children by observation appreciated, and here, open to all, is a large museum, with handiwork of man of all ages and climes, splendid collections of fossils to show, as no text-book will, the history of our earth, and the same with other sciences. I would be very glad to receive any suggestions as to how best the school children could be interested and brought to know the museum of the Academy.

Another project that I hope to see carried out during my lifetime is to have a summer school of science connected with the Academy. It need last but a few weeks and need not be expensive, but, if it did scientific work and helped a few students in their research work into the handbook of nature, it would bring great honor to the Academy and be fulfilling the wishes of its founders.

We regret that the Academy has lost this year, by death, the efficient aid of Mr. J. B. Phelps, a life-long and generous member; also Mr. E. S. Carl and Mrs. J. J. Humphrey.

We close the year with much work accomplished, ready to do more in scientific lines another year, and to prove our usefulness to the city.

We regret that these improvements leave us with an indebtedness of about \$3,000, towards the payment of which \$1,000 has been pledged. The Finance Committee decided to borrow the amount necessary to pay all the bills, trusting to the citizens who have so generously helped us in the past, to do so in the future.

MRS. M. L. D. PUTNAM, *President*.

REPORT OF THE TREASURER.

GENERAL FUND.

RECEIPTS.

Balance on hand Jan. 1, 1900.....	\$	4.10	
By Cash, Subscriptions.....		370.00	
Members' dues.....		167.00	
Gifts.....		365.25	
Door money.....		53.44	
Lectures.....		79.65	
Subscriptions from Endowment Fund.....		50.45	
Sale of books, etc.....		22.20	
Borrowed.....		4,087.98	\$5,200.07

EXPENDITURES.

Academy.....	\$1,052.75	
Library (cataloguing).....	385.35	
Science Hall.....	2,719.69	
Repaid W. C. Putnam (money advanced).....	981.52	
Balance in bank Jan. 1, 1901.....	60.76	\$5,200.07

PUBLICATION FUND.

RECEIPTS.

Balance by cash on hand, Jan. 1, 1900.....	\$	13.97	
By Cash, Putnam Memorial Fund.....		865.52	
Sale of books.....		21.55	
Advanced by W. C. Putnam.....		107.15	\$1,008.19

EXPENDITURES.

Paid Edward Borchardt, printing.....	\$	727.15	
Reid & Mohr, binding.....		101.25	
Heliotype Co., Boston.....		120.00	
Balance in bank Jan. 1, 1901.....		59.79	\$1,008.19

ELIZABETH D. PUTNAM, *Treasurer*.

REPORT OF THE LIBRARIAN.

TO THE OFFICERS AND MEMBERS OF THE DAVENPORT ACADEMY OF SCIENCES:

The year just closed has been one of great activity in this department of the Academy. In each report of your Librarian, for a score or more of years past, a strong plea has been made for a catalogue which would render our large and valuable collection of scientific books available for study. A few years ago a beginning was made with volunteer assistance, but this method was found impracticable for so great an undertaking, and but little was accomplished. Still we had hopes our plea might be heard. How little do we know what a year may bring forth! At the annual meeting one year ago your Librarian urged that this work might be prosecuted with vigor, little dreaming that in one short year to follow he would find the library not only thoroughly classified and arranged, but catalogued as well. Through the efforts of our untiring President, the services of Miss Marion E. Sparks, a competent cataloguer, were obtained, who, with a corps of able assistants, brought order out of chaos. In addition to the usual growth which comes to us by exchange, the library has been greatly enriched by a gift of the Griswold College library, generously donated by the Bishop and Trustees of the College. Before the cataloguing proper could be done, a vast amount of labor and time was necessarily devoted to sorting out duplicates and accessioning the College library. One hundred and twenty-five letters have been written to other societies asking for missing books and pamphlets to complete our sets. About ninety replies have been received and the desired books supplied, while fifteen replies stated the works were out of print. Three stacks of shelving have been placed in the library room, adding 432 feet of shelf room, and providing a place for preservation of large papers, maps, etc. The Academy possesses about 2,000 duplicates, which should be listed for exchange.

Total accessions of books and pamphlets for the year, 1,556, of which 96 are bound.

Of the College gift, 3,168 have been accessioned and catalogued, making a grand total of 4,724 additions to the library; 2,400 works, in 10,200 volumes, have been catalogued; 7,200 cards have been written; 700 printed cards have been received from the United States Department of Agriculture, making the total number of cards 7,900.

C. E. HARRISON, *Librarian*.

A. F. Cutter was elected a life member.

The following officers were elected for the year 1901:

President — MRS. M. L. D. PUTNAM.

First Vice-President — C. A. FICKE.

Second Vice-President — A. W. ELMER.

Recording Secretary — A. A. MILLER.

Corresponding Secretary — W. H. BARRIS.

Treasurer — ELIZABETH D. PUTNAM.

Librarian — C. E. HARRISON.

Curator — W. H. BARRIS.

Trustees — W. L. ALLEN, C. A. FICKE, C. H. PRESTON.

A. F. Cutter was appointed chairman of a committee to encourage pupils of the public schools to visit the museum.

January 26, 1901 — REGULAR MEETING.

Edward S. Hammatt in the chair; eight members and one visitor present.

J. H. Paarmann was elected a regular member.

March 29, 1901 — REGULAR MEETING.

Vice-President C. A. Ficke in the chair; six members present.

C. A. Ficke gave an informal talk on "Ancient Paintings and Idols from Mexico."

June 17, 1901 — TRUSTEES' MEETING.

President Mrs. M. L. D. Putnam in the chair; ten Trustees present.

It was decided to close the museum temporarily. A committee was appointed to raise money for paying the debts of the Academy.

June 28, 1901 — REGULAR MEETING.

President Mrs. Putnam in the chair; six members present.

The President was empowered to employ a zoologist to identify and arrange for exhibition the Academy's collection of birds.

The Committee on Resolutions reported the following, which was adopted and ordered printed:

In the death of Dr. Willis H. Barris, which occurred at his home in this city on the 10th inst., the Davenport Academy of Sciences suffers the loss of a loved and honored associate, whose active interest in its welfare dates from the day of its organization. Made a member and Trustee at its first meeting and elected President in 1876, he also served long and faithfully as its Curator and Corresponding Secretary, conducting its correspondence with scientists in every land, to whom his careful paleontological studies made him personally well known.

Of a gentle and scholarly disposition, holding close and loving communion with nature's visible forms and their informing Spirit, he had neither time nor inclination for business strife with his fellow-men. The soul of kindness in every relation of life, he made each one who came to know him a friend.

Recognizing the rare beauty and value of such a life, be it

Resolved, That we hereby express our sense of the great loss the Academy has sustained in the death of Dr. Barris and extend our deep sympathy to the family in their bereavement.

Resolved, That these resolutions be recorded in our minutes and that copies be sent to the family and to the press.

C. H. PRESTON,

W. C. PUTNAM,

C. A. FICKE,

Committee.

August, 1901 — SPECIAL MEETING.

President Mrs. Putnam in the chair; ten members present.

Miss S. G. F. Sheldon was elected Corresponding Secretary.

October 25, 1901 — REGULAR MEETING.

Vice-President C. A. Ficke in the chair; ten members present.

The Treasurer reported the receipt of the deed to Science Hall.

J. H. Paarmann, who was engaged to revise the collection of birds, reported, in part, as follows:

The collection of mounted birds numbers 437, all in good condition. All specimens, except those from Central America, have been identified. All have been remounted on white stands, labelled, entered in the Accession Catalogue, and installed in new cases. Other zoological collections have been temporarily arranged. More case room is necessary.

Mrs. Henry W. Wilkinson, Providence, Rhode Island, was elected a regular member.

It was decided that the Academy should give a series of lectures in the coming winter. The chair appointed the following Lecture Committee: Mrs. M. L. D. Putnam, Dr. Jennie McCowen, C. H. Preston, J. H. Harrison, and A. A. Miller.

It was decided to open the museum on Wednesday and Saturday afternoons from 1:30 to 4:00, until a permanent curator should be secured.

November 29, 1901 — REGULAR MEETING.

Vice-President C. A. Ficke in the chair; thirty-five members and visitors present.

C. M. Waterman, Mrs. C. M. Waterman, and Monroe Phillips were elected regular members. E. W. Ball, Fort Collins, Colo., was elected a corresponding member.

Prof. Frederick Starr of the University of Chicago, who has been revising the archæological collections in our museum, gave a short talk on their extent and value.

Prof. G. A. Andreen of Augustana College spoke upon "The Future of the Academy."

J. H. Harrison was elected Trustee to fill the vacancy caused by the death of Dr. Barris.

December 27, 1901 — REGULAR MEETING.

Vice-President Ficke in the chair; thirty members and visitors present.

The following papers were read by title and referred to the Publication Committee:

"List of the Orthoptera of New Mexico," by Samuel H. Scudder and Theo. D. A. Cockerell.

"Notes on the Ethnography of Southern Mexico," by Prof. Frederick Starr.

Miss Julia Miller and E. Lage were elected regular members. Prof. G. A. Andreen of Augustana College, Rock Island, Ill., was elected a corresponding member.

Prof. Starr gave a talk on the archæological collections in our museum, and on the needs of the Academy.

February 5, 1902 — ANNUAL MEETING.

C. H. Preston in the chair; nine members present.

Reports of officers:

REPORT OF THE PRESIDENT.

There are a few incidents worthy of note in the history of the past year. The revision of the birds by Mr. Paarmann has made this large collection much more useful to students. The revision of the arrangement of the archaeological collection was begun by Prof. Starr, who spent over five weeks in the work. Prof. Starr's visit was of great benefit to the Academy in many ways. Miss Sheldon's appointment as Corresponding Secretary was a most happy solution of the problem of managing the affairs of this institution in the absence of a curator, and we may congratulate ourselves on the result.

A most important event of the year was the inaugurating of a course of popular scientific lectures. The financial success of these lectures is but a small part of their actual value. They have brought to our city eminent scientific men, who, with one accord, have been astonished at the growth and size of our institution, and who have taken home with them delightful impressions of large and appreciative audiences, and who will retain a keen interest in our future. The lecturers have left behind them most pleasant recollections. By their great generosity in giving their services almost gratuitously they have laid the Academy under lasting obligations.

The gratuitous services of Mr. J. H. Harrison and others, who have spent two afternoons each week since October in keeping open the museum, deserve special mention. After a single newspaper notice at the time of the reopening, over a thousand people have visited the museum in these three and a half months. The opening of the museum on the evenings of the lectures, enabled many to see the collections before the beginning of each lecture. This privilege has been especially appreciated by those who are prevented by their business from coming during the day time. It would be well that sometime in the future an evening be set apart every week for visitors.

I recall with sadness the death of our curator, Dr. Barris, who was for so many years identified with the Academy. We have also lost two other members, Mr. Thomas McClelland and Mr. Chris. Mueller, who have many times lent their aid to the Academy.

M. L. D. PUTNAM, *President.*

REPORT OF THE RECORDING SECRETARY.

During the year 1901 the following meetings were held: six regular meetings, one annual, one special, and one trustees' meeting.

One life member, six regular members, and one corresponding member have been elected during the year 1901.

The Academy has lost one of its life members by the death of the curator, Dr. W. H. Barris.

A. A. MILLER, *Recording Secretary.*

REPORT OF THE TREASURER.

GENERAL FUND.

RECEIPTS.

Balance by cash on hand, Jan. 1, 1901.....	\$ 60.76	
From Subscriptions.....	340.00	
Dues	177.00	
Sale of books	2.00	
Rental of Science Hall.....	89.00	
Door receipts.....	14.07	
New members	15.00	
Interest of Endowment Fund.....	167.15	
Special gifts.....	154.50	
Bequest J. B. Phelps	1,000.00	
Lecture course	126.25	\$2,143.73

EXPENDITURES.

Salaries Dr. Barris	\$ 250.67	
Prof. Frederick Starr.....	120.00	
Mr. J. H. Paarmann	139.30	
Janitor	79.00	
Bird case	93.00	
Stands for birds	28.65	
Improvements on buildings	159.64	
Expense of Science Hall.....	22.37	
Repaid to church fund.....	78.00	
E. D. Putnam	2.00	
Coal.....	61.09	
Water.....	23.00	
Gas	18.26	
Express and sundries	33.55	
Three cases	21.00	
Transferred to Endowment Fund	1,000.00	
Balance on hand, Jan. 1, 1902	14.20	\$2,143.73

PUBLICATION FUND.

RECEIPTS.

Balance by cash on hand, Jan. 1, 1901.....	\$ 59.79	
Sale of books.....	11.92	
Putnam Memorial Fund.....	177.85	
" " "	18.20	\$ 267.76

EXPENDITURES.

Paid for illustrations.....	\$	42.01	
Edward Borchardt, printing.....		99.00	
Egbert, Fidler & Chambers, binding.....		6.80	
Transferred to Publication Endowment Fund....		9.73	
Mr. Udden, preparing Index		30.00	
Balance on hand, Jan. 1, 1902		80.22	\$ 267.76

ACCOUNT OF FUND FOR PURCHASE OF FIRST PRESBYTERIAN
CHURCH PROPERTY.

RECEIPTS.

1899.				
Feb.	27.	Mrs. E. S. Crossett.....	\$	100.00
March	3.	Mrs. Mary P. Adams		100.00
"	6.	C. A. Ficke		100.00
"	8.	Mrs. James Grant		100.00
"	8.	Edward C. Roberts.....		100.00
"	9.	J. J. Richardson		100.00
"	9.	Mrs. M. L. D. Putnam		100.00
"	9.	Miss Elizabeth D. Putnam.....		100.00
"	9.	Mrs. C. A. Ficke		100.00
"	9.	H. H. Andresen.....		100.00
"	9.	F. J. Robinson		100.00
"	14.	Mrs. James T. Lane.....		100.00
"	15.	Paulo Roddewig.....		100.00
"	16.	John Zoekler.....		100.00
"	8.	Church subscription.....		500.00
"	21.	L. P. Best		25.00
"	21.	Sickels, Preston & Nutting.....		25.00
"	22.	Chris. Mueller.....		25.00
"	22.	Mrs. C. C. Parry		25.00
"	22.	Mrs. Maria Purdy Peck.....		100.00
"	22.	Hiram Price		100.00
"	22.	B. R. Putnam		100.00
"	28.	Charles Francis		25.00
April	13.	William Hughes.....		25.00
May	5.	Mrs. William Renwick.....		100.00
"	13.	Mrs. Isabella Sheaff.....		25.00
Sept.	18.	E. S. Carl.....		25.00
Aug.	14.	F. H. Griggs		100.00
Nov.	11.	Mrs. F. J. Robinson		100.00
Dec.	8.	Judge French and family		100.00
Oct.	27.	Credit on insurance.....		25.00
Dec.	29.	Frahm estate.....		100.00
1900.				
March	8.	W. C. Putnam		200.00
"	8.	Interest		3.44
		S. F. Smith		25.00
1901.				
Feb.	1.	Mr. Lindsay		100.00
"	1.	Wilson McClelland		100.00
"	7.	F. J. Robinson		50.00
May	17.	S. F. Smith, } Trustees, estate		
		A. W. Vander Veer, } Ella Wing Parker.		1,626.93
"	18.	Adv. by W. C. Putnam to balance acct...		135.00
				\$5,090.00

EXPENDITURES.

1899						
March	8.	First Presbyterian Church.....	\$	500.00		
"	8.	Paid by Church subscription.....		500.00		
"	9.	First Presbyterian Church.....		600.00		
"	15.	" " " "		200.00		
"	22.	" " " "		500.00		
May	8.	" " " "		150.00		
1900						
March	8.	" " " "		525.00		
1901.						
Feb.	11.	" " " "		350.00		
May	18.	" " " "		1,675.00		
"	18.	" " " "		90.00	\$5,090.00	
		interest ..				

ELIZABETH D. PUTNAM, *Treasurer.*

REPORT OF THE LIBRARIAN.

To the Officers and Members of the Davenport Academy of Sciences :

During the year 1901, the library accessions numbered 1,027 books and pamphlets, nearly all by exchange, none by purchase, and this brief report need bring no discouragement — only regret that we have no funds wherewith to procure, from time to time, scientific works which should be on our shelves and are not otherwise obtainable. Your Librarian, as was clearly understood in advance, has been unable to devote time and attention to the important matter of cataloguing, and by reason of accumulations, some work is here much needed to be done. For this a competent person must be employed and paid. Another need, by no means new, but yet a growing one, is the matter of binding. It is also recommended that one or more suitable cases be placed in the library for the proper display and preservation of some rare books and documents, which would be of increased interest and value thus cared for. I am sure that every member will join me in the wish that means may be speedily provided whereby our library will be improved, strengthened, and made a living, forceful instrument in carrying forward the great educational aims and objects of the Academy. To this end it is hoped an incumbent for this office will be chosen who can and will give time and intelligent attention to the duties involved.

Respectfully submitted,

C. E. HARRISON, *Librarian.*

The following officers were elected for the year 1902 :

President—MRS. M. L. D. PUTNAM.

First Vice-President—C. A. FICKE.

Second Vice-President—DR. A. W. ELMER.

Recording Secretary—A. A. MILLER.

Corresponding Secretary—MISS S. G. FOOTE-SHELDON.

Treasurer—MISS ELIZABETH D. PUTNAM.

Librarian—C. E. HARRISON.

Trustees for Three Years—EDWARD S. HAMMATT, EDWARD C. ROBERTS, W. C. PUTNAM, and J. F. LARDNER.

The following resolution was reported and adopted :

WHEREAS, We believe that valuable educational and practical results may be accomplished by government provision for the extensive study of defectives and others ; therefore

Resolved, That this Academy favors the establishment of a psycho-physical laboratory at Washington, D. C., to coöperate, so far as practicable, with the other institutions engaged in the scientific study of man, in this and other lands.

C. H. PRESTON,
A. A. MILLER,
Committee.

April 16, 1902—TRUSTEES' MEETING.

C. A. Ficke in the chair ; seven Trustees present.

The following resolution was unanimously adopted :

Resolved, That the Trustees of the Davenport Academy of Sciences gratefully acknowledge the donation of a polar bear rug and a walrus skull, by William Ziegler, and do hereby extend sincere thanks to him for the gift.

The following resolution was also unanimously adopted :

Resolved, That J. H. Paarmann be hereby appointed Curator of the Academy at a salary of \$900 for the first year and after that \$1,000 a year.

June 6, 1902—SPECIAL MEETING.

President Mrs. Putnam in the chair ; eight members present.

The Corresponding Secretary gave an outline of talks given to classes from the schools at the Academy museum. A vote of thanks was given to Miss Sheldon for this work.

Miss S. G. Foote-Sheldon, Dr. C. H. Preston and C. E. Harrison were appointed a committee to revise the list of Corresponding Members and decide who shall receive copies of the Proceedings.

The following resolutions were unanimously adopted :

WHEREAS, In the death of Dr. William Drummond Middleton,

which occurred at his home in this city on the 5th of April last, Davenport has lost an illustrious citizen, universally beloved, and the Academy of Sciences a longtime friend and honored member, it is fitting that we record our tribute of sorrowing remembrance and our appreciation of his exceptional worth.

Dr. Middleton's life was one full of inspiration and blessing. To hundreds of young men, both in and out of the medical profession, his personality was the ideal toward which to strive; and the blessing which his skillful hand and kindly presence brought to countless homes in the city and state was attested by the universal sorrow shown at his untimely death.

By unremitting industry he had attained, before middle life, the very foremost rank in his profession, at the same time gaining and holding fast the hearts of all who knew him; and his success was achieved at the cost of no iota of his manhood—no brother's welfare was ever sacrificed to his. With him honor was, first and above all, ingrained, its requirements transcending all set rules of ethics. Few men have made the Golden Rule so thoroughly their guide of life.

Devoted to the special science of his calling, he spared little time for the meetings of this association, but, fully recognizing its educational value, he was always its helpful friend.

The memory of Dr. Middleton will long remain in this Academy, as in the community at large, an inspiration to the noblest living; an uplifting example of pure, strong, and beneficent manhood; of character, culture, and success combined.

Resolved, That we tender herewith our sympathy to his sorrowing family, and that copies of this tribute be transmitted to the press.

C. H. PRESTON,
W. L. ALLEN,
A. W. ELMER,
Committee.

July 25, 1902 — TRUSTEES' MEETING.

President Mrs. Putnam in the chair; seven trustees present.

It was decided to keep open the museum on week-day afternoons from 1 to 5, and on certain Wednesday evenings; admission 10 cents, except on Wednesdays and Saturdays, when no admission shall be charged.

July 25, 1902 — REGULAR MEETING.

President Mrs. Putnam in the chair; ten members present.

The following lecture committee was appointed: J. H. Paarmann, J. H. Harrison, and Elizabeth D. Putnam.

August 8, 1902 — SPECIAL MEETING.

President Mrs. Putnam in the chair; seven members present.

The following resolution was adopted:

Resolved, That the Davenport Academy of Sciences, the work of which for many years past has been largely in the line of American archæology, has learned with pleasure of the suggestion made at the Second International Conference of American States (held at Mexico, 1901-1902) that an International Archæological Commission should be organized.

The usefulness of such an organization is evident. In the promotion of investigation, in the development of scientific methods, in the clear definition of problems, in the establishment of national museums of archæology, in the encouragement of publication of data, and in many other ways such a commission could do much to place American archæology upon a high plane of efficiency.

We urge, then, upon the Directors of the Bureau of American Republics that they shall act favorably upon the suggestion and shall authorize the immediate establishment of such a commission. We assure to the commission, if formed, our hearty interest and sympathy.

This resolution was duly signed and transmitted to the Directors of the Bureau of American Republics.

August 29, 1902 — REGULAR MEETING.

Vice-President C. A. Ficke in the chair.

It was decided to give a concert for the benefit of the Academy, to be held at the Burtis Opera House on September 15, 1902.

September 26, 1902 — REGULAR MEETING.

President Mrs. Putnam in the chair; ten members present.

A resolution thanking those who offered their services gratuitously for the recent concert was unanimously adopted.

On motion, the following were appointed delegates to represent the Academy at the Thirteenth Congress of Americanists: Prof. Frederick Starr, H. S. Putnam, C. A. Ficke, and Mrs. M. L. D. Putnam.

A. F. Ewers was elected a regular member, and W. M. Boehm of Iowa City, a corresponding member.

The Curator read a paper on the subject: "How Can the Museum Best Serve the People?"

October 31, 1902 — REGULAR MEETING.

Vice-President C. A. Ficke in the chair; seven members present. A. F. Ewers gave a talk on "Cryptogams."

November 28, 1902 — REGULAR MEETING.

President Mrs. Putnam in the chair; eight members and two visitors present.

Mrs. Hilda M. Matthey and Mr. H. G. Goldschmidt were elected regular members.

A committee was appointed to make arrangements for the holding of an exhibition of loaned baskets.

Miss Elizabeth D. Putnam gave a report of the meeting of the Congress of Americanists recently held in New York.

December 26, 1902 — REGULAR MEETING.

President Mrs. Putnam in the chair; eight members and one visitor present.

Upon the recommendation of the Committee on Corresponding Members, the following resolution was unanimously passed:

Resolved, That such Corresponding Members, and only such, as are actively engaged in scientific pursuits, shall, on account of membership, be entitled to receive the current publications of the Academy free, if desired.

A. O. Mueller and J. B. Meyer were elected regular members.

January 30, 1903 — ANNUAL MEETING.

C. E. Harrison in the chair; eleven members present.

Reports of officers:

REPORT OF THE PRESIDENT.

In reviewing the work of the Davenport Academy of Sciences for the past year we feel that decided progress has been made.

We have been fortunate in securing a curator, Mr. Paarmann, who can devote his whole time to the advancement of the inter-

ests of the Academy. At this stage of our progress, it is necessary that we have the services of one who can build up the museum and library; one who is able to develop an interest in science by the giving of talks to school children and to the public in general and arousing an interest in our lecture courses. We believe that our present curator is well fitted to succeed along these lines.

An important work of the year has been the lectures given to the upper grades of the grammar schools. Mr. Pratt, in 1889 and 1890, gave talks to the schools on scientific subjects, illustrated by specimens from the collections of the Academy. These talks were highly appreciated. Miss Sheldon, in the spring of 1902, began anew this work, which was continued by the present curator in the autumn. These lectures have been listened to with great interest by scholars and teachers. They have helped more than anything else to bring the Academy into closer touch with the schools. This was one of the earnest hopes of the founders of the Academy; and we feel that their prophecies, written years ago, are being fulfilled.

The United States stands preëminently among the nations in the splendid free education it offers to every citizen. It seems fitting that Iowa, which ranks high among the states in education and politics, should have this unique institution in its midst. Scientists from afar constantly ask: "Why does Davenport have a museum such as this, rather than any other of the hundred cities located similarly in the Mississippi Valley?" The Academy was founded in a broad and liberal spirit that has carried it over periods of depression and doubt till we are sure it will exist as long as Davenport exists. Not everyone sees the usefulness of the study of the advanced sciences, but no one will deny the advantages of a child learning exactness in expression and developing the powers of observation. There is no business man but who longs, often in vain, for these qualities in his employes.

The proper study of zoology, botany, astronomy, and other sciences will give them this training better than anything else. The feeling is growing that museums are for the benefit and education of the public. The importance of this is being realized by other museums. The Museum of Natural History in New York gives regular consecutive lectures on scientific subjects to students, and special lectures to the teachers of the public schools, illustrated by specimens from the museum.

The Academy, with its present limited income, cannot do more than suggest to the child the possibilities before him. These talks take the pupils from the routine of the school-room to another world of the corals and life of the deep sea, and the actual specimens shown him leave more impression than weeks of study from books.

All children are interested in birds, and Mr. Paarmann's talks on the "Coloration and Habits of Birds" have deeply interested the students, and also have shown the powers of observation some have for the birds around them, and the lack of such power in others. The only regret is that a class cannot come again and again during the year.

The free opening of the Academy Wednesday evenings has proved very successful. It has enabled many people who were busy in the day time to visit the museum. As many as 150 persons have been present on a single evening. The Academy is also open free on Wednesday and Saturday afternoons. During the past year 3,505 visitors have registered.

In January, 1902, we inaugurated a series of six scientific lectures, which proved so successful that we were encouraged to continue them this year. From the success of our present course we may call this an established custom that will be continued hereafter.

A number of the musicians of the city kindly offered their services free to give a concert for the benefit of the Academy. It was most successful both from a musical and financial point of view.

We have received many valuable gifts to the museum, which the curator has mentioned in his report. I feel that special mention ought to be made of the gift, from a number of friends of the Academy, of a fine stereopticon. It has been useful in the course of lectures we are now giving and will be invaluable to the curator in his talks to classes from the schools.

The microscope of the late J. Duncan Putnam has also been presented to the Academy. This most precious relic of my departed son was given for the use of all students of nature. It is now twenty-two years since the key of this microscope was turned in the lock, twenty-two years since the eye that loved to search through these lenses the mysteries of myriad insect life, watched with intense interest the development of "nature's tiniest children." Of the work done with this microscope, Professor Kellogg of Leland Stanford, Jr., University, says: "J. Duncan Putnam's paper on the maple bark louse is of great interest in California on account of the scale insects on our fruit trees. One of the first things I give my students is his paper on *Pulvinaria innumerabilis* to show them that there is something more to be known about an insect than its mere name. Mr. Putnam's work is a model of method. The thorough, painstaking research was looked for in Germans, but, until recently, not expected in Americans."

The Academy is grateful to Miss S. G. F. Sheldon for her gratuitous services rendered during the past year in the library work,

in the distribution of our Proceedings, and in the museum. We are indebted to Mr. J. H. Harrison for keeping the museum open twice a week for several months.

There has been but one death among the members of the Academy this past year, and it is the sad duty of the President to announce the death of Dr. W. D. Middleton. He was a member of the Academy since 1874, and we, as all the rest of the community, shall miss the influence of his long membership, and life devoted to science.

While we have done much this year, we hope to do more next year. Our opportunities and needs keep pace with our achievements. It is a sign of growth that the buildings that satisfied us ten years ago are too small for us to-day. The purchase of Science Hall was a wise investment. The friends of the institution came most generously forward to raise the money for the purchase, but the various necessary improvements (the brick connection, new roof, etc.) left a debt of \$3,000. The interest on this note is a burden to the Academy; and it is hoped that the debt may be speedily paid.

The permanent invested endowment of the Academy consists of \$2,200 in the general fund, and \$9,627 in the publication fund. Any addition to these funds will enable the Academy to increase the scope of its work; and it is hoped that, within the near future, they will be materially increased by gifts or bequests from the friends of the institution.

The proper arrangement of the collections already owned by the Academy requires new cases. There is a valuable collection of historical relics which, if attractively exhibited, would prove of great interest to many visitors and also tend to preserve many objects often destroyed or lost in home collections.

In our interest for the present needs of the museum we should not forget that the unique position the Academy holds among museums is due to its collection of pottery and specimens from the mounds. Many great institutions have but a handful of this art of an ancient people. Of these objects the Academy can boast dozens of cases, brought together years ago through the gifts and hard work of its members, who went out and often personally opened the mounds. Such a surprising amount of rare material was revealed that the feeling seems to have grown that the mounds were exhausted. I was talking recently with two noted archaeologists, who spoke of the need for further exploration of the mounds, and would recommend the revival of the "Mound fund," which was an amount of money set aside for the exploration of mounds and the purchase of specimens.

We hope that during the coming summer active field-work may be carried on. The enthusiasm and interest gained in summer

work out doors may be continued by careful research work in the Academy in winter. The day is not far distant, I trust, when we shall have a summer school of science established here, and the hopes of the little band of men and women who founded this institution will then be more than realized.

M. L. D. PUTNAM,
President.

REPORT OF THE RECORDING SECRETARY.

During the year 1902 the following meetings have been held: one annual, six regular, three trustees', and two special meetings.

Five regular members and one corresponding member have been elected during the year.

The Academy has lost a regular member in the death of Dr. Middleton.

At the regular meetings of the Academy two papers have been read, one on the Museum by Curator Paarmann, and a report on the "Congress of Americanists," by Miss Elizabeth D. Putnam.

A. A. MILLER, *Recording Secretary.*

REPORT OF THE CORRESPONDING SECRETARY.

The Corresponding Secretary, Miss Sheldon, reported that much progress had been made during the year in supplying missing parts and volumes in the sets of serials in our library. The publication exchange list has been thoroughly revised. Five foreign institutions, and eight in our own country, have been added to our exchange list. Volume VIII. (1,500 copies) has been received from the printer, and has been distributed as follows:

To foreign institutions.....	250
To institutions in the United States.....	175
To honorary members, etc	25
To regular members.....	

the remainder being stored for future distribution. From the sale of copies of Volume VIII. \$127.25 has been received.

REPORT OF THE TREASURER.

GENERAL FUND.

RECEIPTS.

Amount on hand from 1901	\$ 14.20
From W. C. Putnam, for granitoid sidewalk.....	267.64

From Rent of Science Hall	\$	75.00
Interest of Endowment Fund		74.34
Door money.....		35.69
Subscriptions for stereopticon		119.00
Concert		281.45
Dues of 36 members.....	\$114.00	
Dues and subscriptions of 26 members.....	255.00	
Subscriptions of 13 life members.....	629.00	
Contributions of non-members.....	57.00	1,055.00
		\$ 1,922.32

EXPENDITURES.

Paid granitoid sidewalk	\$	267.64
Repairs: Carpenter work	\$ 94.92	
Papering and painting	123.20	
Plumbing.....	11.37	229.49
Insurance		90.00
Expressage on books	37.16	
Specimens bought.....	9.50	
Books bought	5.60	
Postage	7.60	
Printing.....	25.20	
Bird stands	7.00	
Articles for Janitor	8.22	100.28
Expenses of Science Hall.....		18.95
Interest on note at bank		188.00
Curator		412.50
Expenses of museum		15.00
Janitor		204.90
Coal	74.60	
Water	12.00	
Gas, Electric Light	39.52	126.12
Stereopticon		119.13
Wiring, etc., for stereopticon		31.04
Balance on hand		119.27
		\$ 1,922.32

PUBLICATION FUND.

Receipts.....	\$	865.97
Disbursements.....		831.10
	\$	34.87

ENDOWMENT FUND.

General Endowment Fund	\$ 2,200.00
Putnam Memorial Fund for Publication	9,500.00
Publication Endowment Fund.....	127.25
	\$11,827.25

LIABILITIES.

Note in bank for connection of and repairs on buildings	\$ 3,000.00
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REPORT OF THE LIBRARIAN.

To the Officers and Members of the Davenport Academy of Sciences :

Since the annual meeting of the Academy, February 5, 1902, the number of books and pamphlets received is 1,408. During the early part of the year circumstances were such that but little

work was done on the library. Upon the arrival of Curator Paarmann, his first work, with the assistance of Miss Sheldon, was to complete the cataloguing. This work is now quite complete up to date; and all books and pamphlets are now catalogued soon after they are received. About 2,000 books and pamphlets have been catalogued during the year. The accessions have been along the same lines of scientific interest as those of recent years. Many of the volumes are handsomely bound and beautiful in illustration and typography.

Much time has been spent in perfecting the indexing of the library. Letters of inquiry have been written to a large number of the leading reference libraries and to the various library associations, the Library of Congress, etc. Many indexes have already been received. Many others are expected to be added in a short time. These indexes, together with the card catalogue, make it an easy matter for the reader to find information on any given subject.

The duplicates, of which we have about two thousand, have been removed from the library and placed on shelving prepared for them in a separate room. These books have all been classified according to the Dewey system.

In each annual report of your librarian for several years past a strong appeal has been made for binding. This need has now become a necessity for the preservation of many books which are of great value and cannot be replaced.

To further extend the usefulness of the Academy a reading room should be fitted up, in which such books should be placed as are in greatest demand—up-to-date books on the various sciences, indexes, text-books, and current numbers of scientific publications. Some of these cannot be secured by exchange and should be purchased. Such a room would add greatly to the interest in the library and the usefulness of the Academy. It is very gratifying to report the library in such a flourishing condition. The only regret is that funds have not been available for some of its pressing needs. I hope the very near future may provide for this want.

Respectfully submitted,

C. E. HARRISON, *Librarian*.

REPORT OF THE CURATOR.

(Statistics of visitors, lists of additions to the museum, etc., have been omitted from this report, as they are given at the end of these Proceedings.)

To the Officers and Members of the Davenport Academy of Sciences:

I respectfully submit to you my first annual report.

The increased interest shown in our museum, both by the public and by the schools of Davenport, is very promising. The

opening of the museum free on two afternoons and on one evening each week has done much to increase the attendance. The giving of museum talks to the school children has opened up for the Academy a new sphere of usefulness. These talks were given principally to the upper grades of the grammar schools. The work was begun by our efficient Secretary, Miss Sheldon, in the spring, and continued by your Curator in the fall. Twenty-three classes visited the museum during the fall. The total number of pupils attending in the spring term was 550, and in the fall term, 656.

The subjects of talks were: "Marine Invertebrates," "Colonization of Birds," "The Mound Builders," "Mollusca," "Hydroids and Corals," "Animals of the Sea Bottom."

The fruits of these talks to children have already manifested themselves in the increased attendance of teachers and pupils at our illustrated science lectures, given on Saturday evenings.

We are greatly in need of museum cases. The improved appearance of our collections of birds, in their new cases, shows that other collections might be made more attractive if suitably arranged. It is quite important that a room be fitted up for the storing of our publications, which are at present scattered in a dozen different places in the various buildings.

J. H. PAARMANN, *Curator*.

REPORT OF THE PUBLICATION COMMITTEE.

It is with satisfaction that the Publication Committee report the distribution of Volume VIII. by Miss S. G. F. Sheldon, who revised the list of exchanges. Four hundred copies have been sent out. One hundred and forty copies of Volume VIII. have personally been distributed to members and friends who have generously aided in the support of the Academy. This is customary in all scientific societies, and was inaugurated by the Davenport Academy of Sciences in 1899, when Volume VII. was published. This volume was given only to those who called for it at the Academy. Any member not owning it is entitled to Volume VII. and all future volumes published by the Putnam Memorial Fund.

The volumes published before this fund was created cannot be given away, as only a limited number were published, and by subscription. It is not fair to those members who then paid for their volumes, and thus sustained the publication, now to give the same volumes free to other members.

It has cost over \$10,000 to publish the eight volumes of Proceedings. When we look at our valuable library, which has been acquired in exchange, we feel that the money expended has been a successful investment.

Any member paying the annual dues of three dollars receives free a volume of the Proceedings, as they are published. Correspondence with the principal public libraries has resulted in the sale of books amounting to \$127.00, which has been added to the Endowment Fund.

Since the gift of \$9,500 in 1896 no citizen has been asked to contribute to the publication. The interest from this amount is hardly sufficient to complete a volume in two years.

It has always been the endeavor of your committee to place each volume in the Academy without any indebtedness. To do this has required much patient endeavor and often personal inconvenience.

The publication of Volume IX. was commenced in May, 1902. It contains two valuable papers — one by Samuel H. Scudder and Theodore D. A. Cockerell entitled "First List of the Orthoptera of New Mexico," and the other by Frederick Starr, "Notes Upon the Ethnology of Southern Mexico."

We hope that soon again we will be publishing scientific papers written by our own members, as was frequently done in the early history of the Academy, and more recently in the papers of Dr. Barris and Mr. Miller.

MARY L. D. PUTNAM, *Chairman.*

FINANCIAL REPORT OF PUBLICATION COMMITTEE.

RECEIPTS.

1902.		
January 1.	To balance.....	\$ 80.22
	Interest Putnam Memorial Fund.....	570.00
	Advanced by Mrs. Putnam.....	105.75
	Mrs. Sheaff, gift.....	10.00
	B. R. Putnam, gift.....	100.00
		<u>\$865.97</u>

DISBURSEMENTS.

1902.		
January.	Printing, Edward Borchardt.....	\$493.10
	Binding, Egbert, Fidler & Chambers	106.00
	Drawings and engravings.....	82.00
	Heliotype Company, plates.....	150.00
	Balance on hand January 1, 1903.....	34.87
		<u>\$865.97</u>

COST OF VOLUME VIII.

Edward Borchardt, printing.....	\$ 792.30
Drawing of plates for Prof. Scudder	36.00
Heliotype Company, three plates.....	120.00
Printing of plates for Prof. Starr	56.00
Photogravure of Mr. Pratt's picture	46.00
Mr. Udden, for preparing Index	30.00
Die, from Egbert, Fidler & Chambers	6.50
Reid & Mohr, binding.	101.00
Total.....	<u>\$1,187.80</u>

The following officers were elected for the year 1903 :

President—MRS. M. L. D. PUTNAM.

First Vice-President—DR. A. W. ELMER.

Second Vice-President—DR. C. H. PRESTON.

Curator—J. H. PAARMANN.

Recording Secretary—A. A. MILLER.

Corresponding Secretary—MISS S. G. FOOTE-SHELDON.

Treasurer—MISS ELIZABETH D. PUTNAM.

Librarian—C. E. HARRISON.

Trustees for Three Years—DR. JENNIE McCOWEN, C. E. HARRISON, A. F. CUTTER, J. H. HARRISON.

Trustee for Two Years—J. H. PAARMANN.

January 30, 1903 — REGULAR MEETING.

C. E. Harrison in the chair ; eleven members present.

Mrs. Victoria Sieg was elected a regular member.

February 21, 1903 — TRUSTEES' MEETING.

Dr. A. W. Elmer in the chair ; ten trustees present.

Committees were appointed to prepare resolutions on the death of the late President, Mrs. M. L. D. Putnam, which occurred on the 20th inst., to make arrangements for the funeral, and to provide a floral offering. It was decided that the Academy be draped in mourning for thirty days.

February 27, 1903 — REGULAR MEETING.

President A. W. Elmer in the chair ; twelve members present.

The following resolution, presented by Dr. C. H. Preston, chairman of the committee appointed at the 'Trustees' meeting, February 21, was unanimously adopted :

WHEREAS, Our loved and honored President, Mrs. M. L. D. Putnam, answering to the final summons, has ended her active and beneficent life, which was largely devoted to this institution,

Resolved, That we tender our sorrowing tribute to the memory of one to whom the Academy chiefly owes its continued existence.

While, to an exceptional degree, hers was "the white flower of a blameless life," it was not this alone. To a noble purpose and unflagging zeal she added the rare power of stimulating others to

unselfish work, and so it came that her name is coupled with achievement, that this community and the world of science at large are made her lasting debtors.

Always buoyant and hopeful, never content to rest, her deep interest in the revealing and dissemination of nature's truths, conjoined with a wonderful mother-love, served for years as the mainspring of this Academy's being. To build up a worthy memorial to the son she so loved, while, at the same time, aiding in the advancement of science, she led in our every undertaking, compelling resources where none appeared, bringing light out of darkness and ever refusing defeat. Mainly to her energy is it owing that there is here established an institution which will endure, a legacy which the city will surely appreciate and sustain.

Of her rare womanly and social qualities, her warm heart for suffering, and her devoted home-life we need not speak. Through the work nearest her heart, the Academy publication, she was, perhaps, more widely known and honored abroad than any other Davenport citizen. The community has lost much in the death of Mrs. Putnam, but her task was done: "God's finger touched her gently — and she sleeps."

Resolved, That these resolutions be engrossed and transmitted to the bereaved household with an expression of our deepest sympathy, and that they be spread upon the minutes for publication in our Proceedings.

C. H. PRESTON,
C. A. FICKE,
W. L. ALLEN,
Committee.

The President appointed the following committees for 1903 :

Publication — Miss E. D. Putnam, Edward S. Hammatt, J. H. Paarmann, Dr. C. H. Preston, Prof. Samuel Calvin.

Finance — W. C. Putnam, C. A. Ficke, E. C. Roberts.

Lecture and Entertainment — J. H. Paarmann, Miss E. D. Putnam, J. H. Harrison.

Library — C. E. Harrison, J. H. Paarmann, A. F. Ewers.

Museum —

Zoölogy — J. H. Paarmann.

Conchology — Miss. S. G. F. Sheldon.

Botany — A. F. Ewers.

History — J. H. Harrison.

Ethnology — Miss E. D. Putnam.

Applied Sciences — W. P. Bettendorf.

Archizology—C. E. Harrison.

Geology and Palæontology—Dr. A. W. Elmer.

W. P. Bettendorf and Rabbi William Fineshriber were elected regular members.

March 27, 1903—REGULAR MEETING.

President Elmer in the chair ; twelve members present.

It was decided that from September 26, 1902, in the process of changing the name of the Davenport Academy of Natural Sciences by omitting the word "Natural," one of the important steps had been omitted, and that the change had therefore not been legally made. The President then appointed a committee consisting of W. C. Putnam and C. A. Ficke, to present a notice of the desired change to the Trustees of the Academy.

March 28, 1903—TRUSTEES' MEETING.

President Elmer in the chair ; ten trustees present.

The following resolution, offered by W. C. Putnam and seconded by C. A. Ficke, was unanimously carried :

WHEREAS, On the 26th day of September, A. D. 1902, at a regular meeting of the Davenport Academy of Natural Sciences, there was adopted, by a unanimous vote of the members present, the following resolution, to-wit: "*Resolved*, That the name of the Davenport Academy of Natural Sciences be changed by omitting the word "Natural," and hereafter read "Davenport Academy of Sciences;" and

WHEREAS, The records of the said Academy fail to show conclusively that all of the necessary preliminary steps were taken for the adoption of the aforesaid amendment of the articles of incorporation and the constitution of the said Davenport Academy of Natural Sciences: be it therefore

Resolved, That Article I. of the Articles of Incorporation, and Section I. of Article I. of the Constitution of the said Davenport Academy of Natural Sciences, be amended by omitting therefrom the word "Natural" wherever the same occurs. And

Resolved, That these resolutions be submitted to a succeeding regular meeting of the Academy, with a recommendation from the Board of Trustees that the said amendments be adopted, and that due notice thereof, giving the substance of said proposed amendments, be published in some newspaper in the city of Davenport prior to said regular meeting of the said Academy, and

that C. A. Ficke and W. C. Putnam are hereby appointed a committee on behalf of the trustees to present these resolutions at the regular meeting of the Academy, and to attend to the necessary steps required for the legal adoption of the said amendment.

April 24, 1903 — REGULAR MEETING.

C. A. Ficke in the chair ; ten members present.

The following were elected life members : Mrs. Emma Adele Richardson, J. E. Lindsay, Col. George Watson French, Arthur Davison Ficke, Miss Alice Ficke.

J. H. Paarmann read a paper on "The Embryology of the Chick," illustrated by means of the projecting microscope.

May 29, 1903 — REGULAR MEETING.

President Elmer in the chair ; fifteen members and twenty visitors present.

J. L. Thatcher was elected a regular member.

The following were elected life members : L. P. Best, Edward Berger, Ferdinand Haak, Frank Mueller, A. W. Elmer, E. S. Crossett.

C. A. Ficke, chairman of a committee appointed by the Board of Trustees, presented on behalf of the Board of Trustees of the Academy, with recommendation for its adoption, the following amendment to the Constitution and to the Articles of Incorporation of the Society :

Be it Resolved, That Article I. of the Articles of Incorporation, and Section I. of Article I. of the Constitution of the Davenport Academy of Natural Sciences, be amended by omitting therefrom the word "Natural" wherever the same occurs.

The amendment was adopted by a unanimous vote of the members present.

Prof. E. K. Putnam read a paper on "The value of Natural History for the Student of English."

June 26, 1903 — REGULAR MEETING.

Edward S. Hammatt in the chair.

Routine business was transacted. It was decided to hold no regular meetings during the following July and August.

September 25, 1903 — REGULAR MEETING.

President Elmer in the chair ; eleven members present.

The employment of a cataloguer for a short time, to help complete the cataloguing of the library, was referred to the executive committee.

The finance committee was authorized to employ a janitor at a salary of \$25.00 per month.

A committee was appointed to confer with the Davenport School Board in regard to giving instruction to classes from the schools, at the Academy museum.

October 30, 1903 — REGULAR MEETING.

C. A. Ficke in the chair ; ten members present.

Lieut. H. Kerrick, of the U. S. Recruiting Service, gave an illustrated talk on "Life in the Philippines, with Special Reference to the Schools of Those Islands."

November 27, 1903 — REGULAR MEETING.

C. E. Harrison in the chair.

Routine business was transacted.

[No meeting in December.]

January 29, 1904 — ANNUAL MEETING.

Vice-President C. H. Preston in the chair ; nine members present.

Reports of officers :

ANNUAL ADDRESS OF THE PRESIDENT.

To the Officers and Members of the Davenport Academy of Sciences:

It will soon be half a century since a few gentlemen of our city, interested in the cause of science, beginning in a small way and with a small but enthusiastic membership, founded the Davenport Academy of Sciences.

Since its beginning its membership has increased, its museum enlarged, and its reputation has spread so that it is not alone known in our own country, but has its place among the scientific institutions of the world. Its finances have been well managed, its publications kept up, so that nothing now seems to stand in the way of following out the object of its establishment, viz : "The

increase and diffusion of a knowledge of the natural sciences by the establishment of a museum, the reading and publishing of original papers, and other similar means."

Most of the original members and founders of our Academy have now passed away : but to none of them does our institution owe such a debt of gratitude for unselfish devotion to its needs and untiring zeal in its advancement, as to her whose place I occupy this evening. To give a history of our late President's life would be to give a history of the Davenport Academy of Sciences, in addition to many other good works. Almost to her latest hour she was active in its behalf, and to it she left a most generous bequest to insure its permanent existence and usefulness. In her our institution has lost the best friend it ever had or can have. Her place will ever be vacant, but her spirit will be with us, inspiring us to continue the work which she so long and cheerfully continued for our benefit.

We have one of the finest museums in the West, which in some of its departments is not surpassed by any in the world. Our Archaeological collection pertaining to this country cannot be matched in this or any other country, while the various departments of Geology, Zoölogy, and Ethnology would take high rank in any museum in the land. We have now a well-arranged library devoted to the various branches of science; and, equipped as we are with this wealth of material, it would seem there could be no doubt of the successful achievement of results which have been the aim of the founders and promoters of the Academy.

Are we doing all that the founders of the society could expect from us? Let us look over the reports of the past year and we shall see that we are doing all and more than might be expected of us, busy as most of us are with our business and professions. In the first place, to have the public interested in our objects, it is necessary that the museum be visited by those whose interest is to be awakened. When we learn that, in round numbers, some ten thousand visitors have been admitted to the museum during the past year, we shall see that the work is being carried in a way to excite admiration. Many of the visitors were school children, in whose minds a love of science will be begun, and which will be of the greatest credit to us in the years to come.

The throwing open of the building on certain Sunday afternoons, at the suggestion of the Curator, has proved a success beyond our expectations. On the several occasions on which this was done there was great interest excited. Parties out for a Sunday afternoon walk, seeing the building open, have gone in for the first time and have seen objects never heard of before by them, and interest has at once been awakened which will do good both to them and to us.

Next in importance to the attendance in the museum is the lectures to the teachers and children of our public and private schools. This work, urged by our late president twenty years since, inaugurated by Curator W. H. Pratt some five years later, has, during the past two years, been brought to a state of decided efficiency. It is a work of the greatest importance, and along lines in which the Academy can do the greatest amount of good to the largest numbers. The museum, with its extensive collections, is the most fitting place in the three cities for the teaching of certain branches of science, where the object lesson is of so much value. For the study of the natural sciences our specimens are of the greatest value and afford advantages not often found in a city the size of Davenport. As far as possible, within the limits of the Curator's time, these privileges should be extended to the private schools whose pupils, coming from a distance, will help to make our name known in the land outside of strictly scientific circles, but our public schools must have the preference, as our first duty is to them.

We have been especially successful with our public lectures. They have been well attended, and all have been pleased as well as instructed by the scientific subjects so well presented by the able men whom we have been so fortunate to secure. Subjects so liable to be dry and uninteresting to the general public have been so presented that they have been entertaining as well as instructive, and large possibilities are open to us along these lines. Our museum is steadily growing, over five hundred additions having been made during the year either by gift or exchange, while the arrangement and labeling of specimens have gone on under the able hands of our Corresponding Secretary and Curator.

The library has received many additions during the year, and offers now to those who wish access to strictly scientific literature opportunities seldom obtained in a town of our size. The classification of the works, both by author and subject, makes this mass of knowledge easily reached, and invites both the student and the curious to make use of their contents.

Death has been in our midst since our last annual meeting, and has taken both our late President, Mrs. M. L. D. Putnam, and Mr. J. H. Harrison, one of the Trustees of the Academy. So identified were they with the Academy that it will not seem the same to us now that they are gone.

We certainly ought to feel grateful that they were spared us so long, and had the time to so nearly complete the good work of putting the institution on a firm financial as well as operative basis.

Mrs. W. H. Pratt and Mr. Henry Lischer have also answered to the final call.

We have some needs in the way of further subscriptions to pay off our debt of \$600 incurred in making improvements to the museum building; also subscriptions to help in providing more space for the many specimens which at present have no cases nor any provision for their safety and preservation. The library requires the expenditure of some money for binding of volumes, which will be inaccessible until they are bound, to say nothing of being unprotected in their present state.

Many points which have been omitted from my report will be found in the reports of our other officers, to which I would refer you.

A. W. ELMER.

REPORT OF RECORDING SECRETARY.

During the past year nine regular meetings of the Academy, two trustees' meetings and one annual meeting have been held.

Three papers were presented at these meetings. Curator Paarmann spoke on "The Embryology of the Chick," Prof. Edward K. Putnam on "The Value of Natural History in the Study of Literature," and Lieut. Kerrick on "Life in the Philippines, With Special Reference to the Schools of Those Islands."

A. A. MILLER, *Recording Secretary*.

REPORT OF CORRESPONDING SECRETARY.

Acknowledgments of receipt of publications to the number of 1,190 were sent out.

Received from sale of Proceedings, \$69.50.

SARAH G. F. SHELDON, *Corresponding Secretary*.

REPORT OF THE TREASURER.

GENERAL FUND.

RECEIPTS.

Balance on hand Jan. 1, 1903	\$ 133.80
By cash Rental of Science Hall.....	66.00
Interest on Endowment Fund.....	198.00
Basket exhibit	60.00
Net receipts, Lecture Course	120.95
Subscriptions towards building improvements.	2,100.00
Door money	40.40
Tuition.....	7.00
Sale of duplicate books.....	31.95
Special gifts	37.00
Dues	142 00
Subscriptions.....	1,006.50
	<u>\$3,943.60</u>

EXPENDITURES.

Paid on note at bank account building improvements...	\$2,100.00
Interest	90.84
Insurance	92.00
Curator's salary	948.81
Janitor	259.10
Coal	\$106.18
Water	10.75
Gas	13.44
	130.37
Repairs	71.23
Museum cases	41.50
Taxidermy (mounting birds)	54.55
Books	10.50
Binding	43.30
Curator's expenses	62.73
Expressage	7.92
Balance on hand Jan., 1904	30.75
	\$3,943.60

PUBLICATION FUND.

RECEIPTS.

Balance on hand Jan. 1, 1903	\$ 34.87
By cash, Putnam Memorial Fund	570.00
Interest	1.67
	\$ 606.54

EXPENDITURES.

Paid to General Fund, repayment of loan	100.00
Edward Borchardt for printing	235.40
Balance on hand Jan. 1, 1904	271.14
	\$ 606.54

ENDOWMENTS.

General Endowment Fund	\$ 2,200.00
Putnam Memorial Fund for publishing Proceedings	9,500.00
Publication Endowment Fund	127.25
	\$11,827.25

The gift of the late Mrs. Mary L. D. Putnam, under the provisions of her will, largely increasing the endowment of the Putnam Memorial Fund, is not yet available, and so is not included in the foregoing statement.

ELIZABETH D. PUTNAM, *Treasurer*.

REPORT OF THE LIBRARIAN.

To the Officers and Members of the Davenport Academy of Sciences :

Your Librarian begs to report for the year 1903 as follows:

STATISTICS.

Accessions for the year 1903	1,190
No. of bound books in library	5,045
No. of unbound books in library	1,325
No. of pamphlets in library, about	37,800
Books and pamphlets in duplicate room	2,000

ACQUISITIONS BY PURCHASE.

Hawkeye (bound), 12 volumes.
 Lippincott's Pronouncing Gazetteer.
 Scudder—Every-day Butterflies.
 Chapman—Bird Life.
 Museums Journal, 3 volumes.
 Kroeger, Alice B.—A. L. A. Guide to Reference Books.
 Cutter—Sanborn Author Tables.
 Webster's International Dictionary.
 Comstock—Manual for the Study of Insects.
 Marshall & Hurst—Practical Zoology.
 Piersol—Normal Histology.
 Flower & Lydekker—Mammals, Living and Extinct.
 Wright—Optical Projection.
 Hornaday—Taxidermy.
 Meyer, A. B.—Über einige Museen des Ostens der ver. Staaten von Nord America, 2 volumes.
 Über einige Europäische Museen.

WORK DONE.

About 95 per cent of the accessions of the past year have been catalogued and installed on the shelves. Many bibliographical works have been added to supplement the card catalogue. Several hundred duplicates have been exchanged. Much time was spent in sending for missing numbers in order to complete many of our sets of serial publications. A large number of these were obtained.

BINDING.

A beginning has been made in the way of much needed binding. Forty books were bound during the year. It is of the utmost importance that this good work continue, and I earnestly hope that provision may be made for it without delay.

C. E. HARRISON, *Librarian*.

REPORT OF THE CURATOR.

[Donations to the museum, statistics regarding visitors, etc., will be found at the end of these Proceedings.]

To the Officers and Members of the Davenport Academy of Sciences :
 I respectfully submit to you my second annual report.

PRESENT STATE OF THE MUSEUM.

Palaeontology—12,000 specimens: mineralogy, 11,000 specimens: structural geology, 600 specimens: economic geology, 300 specimens.

Zoölogy—39,000 specimens: 50 mammals; 615 birds, mostly North and Middle American, being most complete in Iowa and Illinois birds—all mounted; 200 birds' eggs; 100 osteological specimens, 100 reptiles, 100 fishes, a complete series of Upper Mississippi River shells, numbering about 10,000 specimens; 500 shells from other rivers; a good collection of marine shells (about 10,000 specimens); 15,000 insects, including many type speci-

mens; 250 specimens of coral, occupying a wall case 8 feet by 24 feet; 2,000 other invertebrates, mostly Porifera, Echinodermata, and Arthropoda (Crustacea).

Botany — A fairly complete series of the plants of the Upper Mississippi Valley.

Archæology and Ethnology — 23,500 specimens: 1,300 specimens of ancient pottery from Arkansas, Tennessee, etc.; 12 from mounds of the Upper Mississippi Valley and 16 from the Cliff Dwellings; stone implements, mostly from Upper Mississippi Valley, as follows: 14,600 chipped implements (arrowheads, spearheads, etc.), 1,200 pecked implements (axes, celts, etc.), and 800 polished implements (ornaments, discoidal stones, etc.); also 350 bone implements from mounds of the Upper Mississippi Valley, 64 carved pipes, from mounds of Iowa and Illinois; 2,000 shell beads and 50 other articles of shell, all from mounds of the Mississippi Valley; 34 copper axes, 300 copper beads, and 36 other copper articles, from Iowa mounds; 108 crania from mounds of the Mississippi Valley, and 30 crania obtained from recent Indian graves; 1,000 miscellaneous mound relics and 1,400 recent Indian relics; 150 ethnological specimens from Mexico, 30 from the Micronesian Islands, and 25 from the Eskimos; 1 mummy and mummy case from Egypt.

History — 400 specimens.

The library consists mostly of scientific periodicals and the publications of scientific societies, including the scientific publications of the United States government, local history also being fairly well represented. The library is catalogued by author and subject. Books, 6,370; pamphlets, 37,800.

IMPROVEMENTS MADE.

Miss Sheldon has classified and arranged our collection of marine shells and has made available for exchange our very large duplicate series. Miss Sheldon has also prepared a synoptic series of minerals, also series illustrating structural and economic geology. Group labels for all these have been placed in the cases, but the labels for the individual specimens still remain to be written. We have identified and labelled about half of our collection of Mexican birds. Many of the smaller collections have been put in better order, and supplied with instructive labels, yet there is an enormous amount of work which still remains to be done.

TALKS TO TEACHERS AND PUPILS.

During the past year all of the public schools of the city, and several of the private schools, have sent classes to the museum. Besides the classes from our own city, many attended from other places — from country schools and from neighboring towns, also

from Rock Island and Port Byron, Ill. A special room has been fitted out, in which short talks are given to the children. These talks are illustrated by means of specimens taken from our collections. After this instruction, the teacher in charge takes the class through the museum. It is quite evident that not much more may be accomplished during such an occasional visit, than to awaken in the children a love for nature. The interest once developed, it is necessary that it should be kept up throughout the year. For this purpose the teachers themselves must have an interest in natural history. In order that such interest might be developed, a bird study class was organized. Eighty-two teachers enrolled in the class, which met in two sections every week during the entire spring of 1903. After a short course of lectures on bird-life, the remainder of the term was devoted to laboratory work. It is believed that, besides the interest which this work aroused, the class learned better methods of studying nature, and incidentally acquired considerable information that afterwards proved helpful in the schoolroom.

For the benefit of the teachers, 5,000 copies of a "Preliminary List of the Birds of Davenport and Vicinity" were printed. A list of museum talks to the school children was prepared for the school year 1903-4, and distributed among the teachers of the city.

During the school year, 1902-3, 72 museum talks were given, the total attendance being 2,406 — average attendance, 33.4.

LECTURES.

Eight illustrated lectures on Natural Sciences were given in Science Hall during the year. The average attendance at these lectures was about 300. All of the lecturers were furnished by the University of Iowa, except one, who was from the University of Chicago. Occasional papers and one illustrated talk were given at our regular monthly meetings.

FIELD WORK.

In October a party of seven persons excavated what was supposed to be an artificial mound, about three miles south of Blue Grass, in this county. No relics were found.

OUR NEEDS.

Our greatest needs at present are binding for the books in our library and additional cases for our museum specimens. The valuable books and specimens which have been intrusted to our care should be put in such shape that they will be preserved against dust, improper handling, etc. Let us take upon us, for the coming year, the obligation of raising a fund of \$500 for bind-

ing and an equal amount for museum cases. These needs are so imperative, they having been uttered again and again for the last twenty years, that we may justly lay aside some of our other plans and see that a fund for this purpose is raised.

J. H. PAARMANN, *Curator*.

The following officers for the year 1904 were elected:

President—DR. A. W. ELMER.

Vice-President—DR. C. H. PRESTON.

Curator—J. H. PAARMANN.

Recording Secretary—A. A. MILLER.

Corresponding Secretary—MISS S. G. FOOTE-SHELDON.

Treasurer—MISS ELIZABETH D. PUTNAM.

Librarian—C. E. HARRISON.

Trustees for Three Years—Dr. W. L. ALLEN, C. A. FICKE,
DR. C. H. PRESTON.

Trustee for Two Years—(to fill vacancy caused by death of J. H. Harrison) Miss S. G. FOOTE-SHELDON.

ELECTIONS TO MEMBERSHIP.

MAY 1, 1901, TO JANUARY 29, 1904.

HONORARY MEMBERS.

Baron Charles R. Osten Sacken, Heidelberg, Germany	January 29, 1904
Marquis de Nadaillac, Paris, France	January 29, 1904
Duc de Loubat, Paris, France	January 29, 1904
Dr. David Starr Jordan, Palo Alto, California	January 29, 1904
Dr. L. W. Andrews, Iowa City, Iowa	January 29, 1904
Dr. L. O. Howard, Washington, D. C.	January 29, 1904
Dr. Charles A. White, Washington, D. C.	January 29, 1904
Prof. W. H. Holmes, Washington, D. C.	January 29, 1904
Prof. F. W. Putnam, Cambridge, Mass.	January 29, 1904

CORRESPONDING MEMBERS.

Elmer D. Ball, Fort Collins, Colorado	November 29, 1901
Prof. G. A. Andreen, Augustana College, Rock Isl- and, Illinois	December 27, 1901
W. M. Boehm, Iowa City, Iowa	September 26, 1902

REGULAR MEMBERS.

Mrs. Anna R. Wilkinson, Providence, R. I.	October 25, 1901
C. M. Waterman	November 29, 1901
Mrs. C. M. Waterman	November 29, 1901
Monroe Phillips	November 29, 1901
Miss Julia Miller	December 27, 1901
E. Lage	December 27, 1901
A. F. Ewers	September 26, 1902
Mrs. Hilda M. Matthey	November 28, 1902
H. G. Goldschmidt	November 28, 1902
A. O. Mueller	December 26, 1902
J. B. Meyer	December 26, 1902
Mrs. Victoria Sieg	January 30, 1903
W. P. Bettendorf	February 27, 1903
William Fineshriber	February 27, 1903
J. L. Thatcher	May 29, 1903
Henry E. C. Ditzen	January 29, 1904

LIFE MEMBERS.

Mrs. Emma A. Richardson	April 24, 1903
J. E. Lindsay	April 24, 1903
George Watson French	April 24, 1903
Arthur Davison Ficke	April 24, 1903
Miss Alice Ficke	April 24, 1903
L. P. Best	May 29, 1903
Edward Berger	May 29, 1903
Ferdinand Haak	May 29, 1903
Frank Mueller	May 29, 1903
A. W. Elmer	May 29, 1903
E. S. Crossett	May 29, 1903

VISITORS TO THE MUSEUM.

The following table shows the number of visitors to the museum during the past ten years. The figures were obtained from the Visitors' Register. Since, however, many visitors neglect to register, these statistics are not absolutely correct, all the numbers probably being too small. An examination of the table will show that the increase in the size of the museum, after the fitting up of a part of Science Hall, and the re-arrangement of the collections, during 1901 and 1902, was accompanied by a corresponding increase in the attendance.

The large attendance during October and November, 1902, was due to the opening of the museum on Wednesday evenings: and that of November and December, 1903, to the opening of the museum on one Sunday afternoon each month. At the first Sunday opening there were 519 visitors present, and at the second 573. The attendance of teachers during the spring of 1903 was due to the holding of the Teachers' Institute in Science Hall, and to the Teachers' Bird Study classes.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1894.....	11	6	52	27	152	34	39	20	49	51	11	29	481
1895.....	13	8	50	83	54	32	33	50	33	48	16	9	429
1896.....	57	31	35	25	125	54	31	57	80	39	32	15	581
1897.....	24	17	25	28	7	60	26	31	59	55	19	14	365
1898.....	30	20	26	31	46	72	45	54	21	27	19	14	405
1899.....	16	10	63	48	149	62	60	52	27	27	36	20	570
1900.....	18	20	27	13	25	126	34	58	41	47	53	18	480
1901.....	31	8	32	48	112	55	27	Closed	27	224	85		649
1902.....	53	49	85	169	299	212	132	452	401	764	639	250	3505
1903 - Regular.....	185	90	185	231	243	356	312	330	197	241	669	709	3748
Teachers.....			300	376	357	45							1078
Pupils in classes.	235	42		390	1007	290				130	51	127	2272
Basket Exhibit..			2500										2500
1903 - Total	420	132	2985	997	1607	691	312	330	197	371	720	836	9598

ADDITIONS TO THE MUSEUM.

1901-1903.

I.—DONATIONS.*

GEOLOGY.

Ankerson, Miss.

2 "Petoskey" pebbles.

Bennett, A. T., Mt. Ayr, Iowa.

3 bones of mammoth Frontier County, Neb.

Bills, Mrs. J. C.

9 specimens of minerals.

Hall, B. S.

Minerals.

Helmick, J. M.

Fossil (Lepidodendron?) Scott County, Iowa

Humphrey, J. J., and family.

Case of miscellaneous specimens, mostly minerals collected by the late Mrs. Humphrey.

Tuttle, Mrs. F. M.

Drawing and description of a meteorological phenomenon occurring at Osage, Iowa, Feb. 19, 1901.

ZOOLOGY.

Ballord, Webb.

2 starfish.

Barclay, Hettible.

Oven Bird. *Seiurus aurocapillus* (Linn.) Davenport, Iowa

Cepican, Mary.

Bank Swallow. *Clivicola riparia* (Linn.) Davenport, Iowa

Crans, A. W.

Vertebra of whale.

Octopus (alcoholic specimen).

Elmer, Theo., Astoria, Oregon.

California Murre *Uria troile californica* (Bryant) .. Washington (state)

Elmer, Dr. A. W.

Skeleton of wolf, turtle, rat, and dog.

Skeleton (parts) of muskrat, deer, and goose.

Ficke, C. A.

Autumnal Parrot ♀ *Amazona autumnalis* (Linn.) Mexico— Parrot *Myiopsitta lincola* (Cass.) "Yellow-billed Cuckoo ♀ *Coccyzus americanus* (Linn.) "2— ♂ ♀ *Piaya cayana nichleri*(?) "Citreoline Trogon ♀ *Trogon citreolus* Gould "2 Xalapa Trogon ♂ *Trogon puella* Gould "Resplendent Trogon ♂ *Pharomachrus mocinno costaricensis* ..

..... Costa Rica

Blue-crowned Motmot ♂ *Monetus ceruleiceps* Gould ... MexicoGreat Rufous-bellied Kingfisher ♂ *Ceryle torquata* (Linn.) "Texan Kingfisher ♀ *Ceryle americana septentrionalis* Sharpe. "Guatemalan Ivory-billed Woodpecker ♂ *Campephilus guate-**malensis* (Hartl.) "Scissor-tailed Flycatcher ♂ *Mitralus forficatus* (Gmel.) "2 Green Jay ♂ ♀ *Xanthoura luxuosa* (Less.) "

* Residence of donors, Davenport, Iowa, unless otherwise specified.

- Sumichrast's Blackbird ♂ *Dives dives* (Lichtenstein).....Mexico
 Brewer's Blackbird ♂ *Scolecophagus cyanocephalus* (Wagler). "
 2 Black-headed Oriole ♂ ♀ *Icterus melanocephalus melanoceph-* "
alus (Wagler) "
 Baltimore Oriole ♂ *Icterus galbula* (Linn.) "
 Alta Mira Oriole ♂ *Icterus gularis tamaulipensis* Ridgway... "
 Mazatlan Cardinal ♂ *Cardinalis cardinalis sinaloensis* Nelson "
 2 Western Blue Grosbeak ♂ ♀ *Guiraca caerulea lazula* (Lesson) "
 Rose-breasted Grosbeak ♂ *Zamelodia ludoviciana* (Linn.) "
 Western Chipping Sparrow ♂ *Spizella socialis arizonæ* Coues. "
 2 Abbot Tanager ♂ ♀ *Tanagra abbas* Lichtenstein..... "
 Hepatic Tanager ♀ *Piranga hepatica* Swainson "
 White-rumped Shrike ♂ *Lanius ludovicianus* (Swains.)..... "
 2 Black and White Warbler ♂ ♀ *Mniotilta varia* (Linn.)..... "
 Texas Thrasher ♂ *Harporhynchus longirostris sennetti* Ridgw. "
 Ruby-crowned Kinglet ♂ juv. *Regulus calendula* (Linn.)..... "
 83 birds (not yet identified)..... "
 French, Mrs. G. W.
 Brown Pelican. *Pelecanus fuscus* Linn..... Louisiana
 Goodwin, Mable.
 Red-headed Woodpecker. *Melanerpes erythrocephalus* (Linn.)
 Davenport, Iowa
 Leland Stanford University.
 3 jars zoölogical specimens.
 McClelland, Nelson.
 Yellow-billed Cuckoo. *Coccyzus americanus* (Linn.). Davenport, Iowa
 Martin, Woods & Co.
 Tarantula and nest.
 Mills, Mrs. Helen M., Rock Island, Ill.
 American Woodcock. *Phalohela minor* (Gmel.)... Rock Island, Ill.
 Prairie Sharp-tailed Grouse. *Pediocates phasianellus campes-*
tris Ridgw..... Rock Island, Ill.
 Oberholtzer, Ernest.
 Butterflies and beetles (several hundred specimens).
 Paarmann, J. H.
 2 Prairie Horned Lark ♂ ♀ *Otocoris alpestris praticola* (Hensh.)
 Scott County, Iowa
 Putnam, Mrs. M. L. D.
 Ostrich egg.
 Head of Canada Lynx. *Lynx canadensis* (Desmarest).
 Putnam, W. C.
 Skin of a Boa Constrictor.
 California Gull. *Larus californicus* Lawr.
 Red-breasted Merganser. *Merganser serrator* (Linn.).
 Tufted Titmouse. *Parus bicolor* (Linn.).
 Wood Pewee. *Contopus virens* (Linn.)..... Rock Island Co., Ill.
 Vireo..... " " " "
 Indigo Bunting ♀ *Passerina cyanea* (Linn.)..... " " " "
 English Sparrow ♂ *Passer domesticus* (Linn.).... " " " "
 English Sparrow ♀ *Passer domesticus* " " " "
 Ring-necked Pheasant. *Phasianus torquatus* Gmel..... Oregon
 Herodiones sp..... Hungary
 Limicolæ sp..... Germany
 White Stork. *Ciconia alba*..... Roumania
 Cuckoo. *Cuculus canorus* Roumania

- Kingfisher. *Alcedo ispida* Hungary
 Little European Bustard. *Otis tetrax* Spain
 White Wagtail. *Motacilla alba* Roumania
 Starling. *Sturnus vulgaris* Germany
 Hoopoe. *Upupa epops* France
 Chaffinch. *Fringilla coelebs* Germany
 Quail. *Coturnix communis* Hungary
 Wryneck. *Yunx torquilla* Germany
 Great Spotted Woodpecker. *Dendrocopos major* Germany
 Red-eyed Vireo. *Vireo olivaceus* (Linn.).
 Least Bittern. *Botaurus exilis* (Gmel.).
 Tetraonidæ sp Siberia
 Little Striped Skunk. *Spilogale interrupta* (Rafinesque) ... Illinois(?)
 Gray Fox. *Urocyon cinereo argenteus* (Müller) Mercer Co., Ill.
 Schebler, Mrs. Frank J.
 Gurnard North Sea, Europe
 Schutter, Henry.
 Hermit Thrush. *Turdus aonalaschkæ pallasii* (Cab.) . Davenport, Ia.
 Shado, Mable.
 Red-winged Blackbird. *Agelaius phoeniceus* (Linn.) . Davenport, Iowa
 Sheldon, Miss S. G. F.
 Black-winged Tanager. *Tanagra palmarum melanopectera*
 (Sclater) Central America
 Blue Tanager. *Tanagra cana* Swainson " "
 2 Bonaparte's Tanager ♂ *Ramphocelus luciani* Lafresnaye
 Central America
 Yellow-rumped Tanager. *Ramphocelus icteronotus* Bonaparte
 Central America
 7 birds (not yet identified) " "
 Ziegler, Wm., New York.
 Polar Bear, collected during the 1st exped. sent out by Mr.
 Ziegler North of Franz Josef Land
 Walrus Skull Greenland

ARCHÆOLOGY AND ETHNOLOGY.

- Burns, Mrs. M. C.
 Fish-scale wreath made by Indians.
 Belt of Indian beadwork.
 Ficke, C. A.
 16 pieces of ancient pottery Mexico
 Stone implement "
 8 spindle whorls "
 String of stone beads "
 3 terra cotta figures "
 19 small terra cotta heads "
 Hall, B. S.
 A large number of arrow-heads.
 Holmes, Miss Clara M.
 4 specimens of modern Indian work.
 Hovey, Geo. U. S., White Church, Kansas.
 A small stone head Wyandotte County, Kansas
 3 celts.
 Moore, Clarence B., Philadelphia, Pa.
 5 plaster casts of aboriginal implements of stone from Florida mounds.

- Palmer, Mrs. M. S.
 7 arrow-heads (obsidian) Snake River Valley, Idaho
 Spear-head " " " "
- Parry, Mrs. Dr. C. C.
 Rope..... Mexico
 2 brushes..... "
 Smoking cap "
 Siamese book.
- Putnam, Miss E. D.
 2 specimens of modern Indian work.
- Putnam, E. K.
 15 flint implements of stone age..... England
 2 flint chips Egypt
- Putnam, H. S.
 A pair of "sabots" Spain
- Putnam, Mrs. M. L. D.
 Gun sack made by Sac and Fox Indians.
- Putnam, W. C.
 16 articles used by the Iroquois in their games and religious ceremonies,
 coll. by Prof. F. Starr.
 Mazatec Garments, coll. by Prof. F. Starr Huauhtla, Mexico
 1 Tarascan belt, " " " " State of Michoacan, "
- Renwick, Miss M.
 5 specimens of Neolithic pottery... Province of Brandenburg, Prussia
- Roundy, W. N., Chicago, Ill.
 Pot from a mound Madison County, North Carolina
- Starr, Prof. Frederick, Chicago, Ill.
 4 spindle whorls Mexico
- Tieman Wm., New Boston, Ill.
 2 potsherds, from a mound..... Mercer County, Ill.

MISCELLANEOUS.

- Behr, A., Pasadena, Cal.
 Cranium of a native..... Catalina Island, Lower California coast
 Stone implements.
 Shells.
 Nautilus.
- Brammer Mfg. Co.
 Museum case.
- Brayton, Benj. B.
 2 specimens of old currency.
- Ficke, C. A.
 Bird case.
- Fulton, A. C.
 Photograph of ice gorge at Davenport, 1868.
- Harrison, C. E.
 Ramie fibre.
- Lindsay, R. E.
 Trunk, once owned by Chief Blackhawk.
- Melchert, Mrs. J.
 2 specimens of pottery of old German make, apparently covered with
 a plating of silver.

Putnam, H. S.

A collection of South American money, chiefly from Paraguay.

Putnam, Mrs. M. L. D.

Writing desk.

Microscope of J. Duncan Putnam.

Schaefer, Mrs. Lena.

Spinning wheel (over 200 years old).....Hesse-Darmstadt, Germany

Matthey Bros.

Peck, Mrs. F. W.

Ficke, C. A.

Lane, Mrs. Joe.

Putnam, W. C.

Allen, Dr. W. I..

Hurst, Mrs. E. W.

Cable, Mrs. G. W.

Deere, Mrs. C. H.

Brandt, Miss C.

Ryan, Ed.

Wadsworth, Mrs. W. C.

Richardson, Mrs. J. J.

Nadler, Frank.

Cook, Mrs. E. E.

Elmer, Dr. A. W.

Davison, Mrs. Abner.

Parry, Mrs. Dr. C. C.

Davison, Miss Ella.

} Stereopticon, projecting microscope, curtain, and accessories.

II. ACQUIRED BY EXCHANGE.

(♂, except when otherwise indicated.)

Putlin. *Fratercula arctica* (Linn.) Labrador

Pigeon Guillemot. *Cephus columba* Pall.

Noddy. *Anous stolidus* (Linn.) Bahamas

Black Skimmer. *Rhynchops nigra* Linn. Texas

Leach's Petrel. *Oceanodroma leucorhoa* (Vieill.)... New Brunswick

Anhinga. *Anhinga anhinga* (Linn.).

Man-o'-War Bird. *Fregata aquila* (Linn.)..... Texas

Canada Goose. *Branta canadensis* (Linn.) Nebraska

Fulvous Tree Duck. *Dendrocygna fulva* (Gmel.)..... Texas

Sandhill Crane. *Grus mexicana* (Müll.)..... Nebraska

Wilson's Phalarope. *Phalaropus tricolor* (Vieill.)..... Texas

Willow Ptarmigan. *Lagopus lagopus* (Linn.)... N. W. Terr. Canada

Turkey Vulture. *Cathartes aura* (Linn.)..... Arkansas

Golden Eagle. *Aquila chrysaetos* (Linn.).

Carolina Paroquet. *Conurus carolinensis* (Linn.)..... Louisiana

Bobolink ♀ *Dolichonyx oryzivorus* (Linn.) Nebraska

2 Song Sparrow ♂ ♀ *Melospiza fasciata* (Gmel.)..... Nebraska

Fox Sparrow. *Passerella iliaca* (Merr.) Iowa

Purple Martin. *Progne subis* (Linn.) Texas

Cliff Swallow. *Petrochelidon lunifrons* (Say.)..... Iowa

Mocking Bird. *Mimus polyglottos* (Linn.)..... Texas

Brown Creeper. *Certhia familiaris americana* (Bonap.).

Ruby-crowned Kinglet. *Regulus calendula* (Linn.)..... Illinois

Wilson's Thrush. *Turdus fuscescens* Steph.

Hermit Thrush. *Turdus aonalaschkae pallasi* (Cab.) Illinois

Olive-backed Thrush. *Turdus ustulatus swainsonii* (Cab.).... Iowa

LECTURE COURSES.

1902.

January 4—"The Snake Dance of the Mokis"—Dr. J. W. Fewkes.

January 11—"The Degenerates of Animal Society"—Prof. H. B. Ward.

January 18—"The Glacial Period in Iowa"—Prof. Samuel Calvin.

January 25—"Members of an Ancient Family"—Prof. T. H. Macbride.

February 1—"The Aztecs of Ancient Mexico"—Prof. Frederick Starr.

February 8—"The Bottom of the Sea"—Prof. C. C. Nutting.

1903.

January 10—"From Minneapolis to Lillooet, British Columbia. What a Geologist Sees on the Way"—Prof. Samuel Calvin.

January 17—"The Sonora Desert"—Prof. Thomas H. Macbride.

January 24—"Life on Board the U. S. S. 'Albatross'"—Prof. C. C. Nutting.

January 31—"The Hawaiian Islands: Particularly Some Little-Known Ones"—Prof. C. C. Nutting.

February 7—"The Iroquois Indians"—Prof. Frederick Starr.

February 14—"Are Other Worlds Inhabited?"—Prof. Lænas G. Weld.

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Mary L. D. Putnam

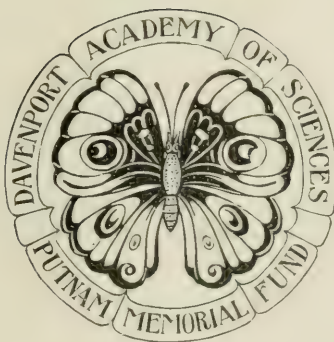
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MARY LOUISA DUNCAN PUTNAM

WILLIAM CLEMENT PUTNAM

MARY LOUISA DUNCAN PUTNAM.

A MEMOIR.

BY ELIZABETH DUNCAN PUTNAM.

MARY LOUISA DUNCAN was born on September 23rd, 1832, in Greencastle, Pennsylvania. She was the second child and eldest daughter of Joseph Duncan and Elizabeth Caldwell Smith. The family home was in Illinois, but Mr. Duncan was in Congress from 1826 to 1834. When the epidemic of cholera broke out in Washington in 1832 Mrs. Duncan sought refuge in Greencastle, where some Scotch cousins lived. Shortly after the birth of their daughter Mr. and Mrs. Duncan returned to Washington, D. C., their home for the next two years.

Both heredity and environment had a marked influence on the life of Mary Duncan. She was descended on both sides from Scotch and Huguenot ancestors.

Her father was the son of Major Joseph Duncan of Virginia, who in 1790 moved to Paris, Kentucky. The handsome stone house that he built still stands on the old square in Paris. Here his son Joseph was born in 1794. Major Duncan died in 1806, leaving a widow and six children. Joseph was the third son, but when he was twenty-one he was appointed guardian for his younger brothers. When the war of 1812 broke out he enlisted as an ensign. He was a man of great physical strength and bravery, and these qualities were often severely tested during the war. One time he was the bearer of dispatches to the Army of the Northwest and was obliged to go through the trackless forests, where he had many narrow escapes, as the Indians were friendly to the English. He aided in the defense of Fort Stephenson, at Lower Sandusky, now Fremont, Ohio, in 1813. Orders had previously come from General Harrison to Major Croghan, the commanding officer, to abandon the fort. A council of war was called,

and Duncan, as the youngest officer, was first asked to express his opinion. He answered decidedly in favor of defending the fort, "the order to the contrary notwithstanding." The majority were of like mind, and the small band of one hundred and forty men held the fort against several thousand British and Indians. The officers were court-martialed for disobeying orders, but were acquitted; and in 1834, Congress presented Major Croghan with a medal, and Duncan and the other officers with gold-mounted swords. The defeat of the British at this period had an important effect upon the war, preventing their occupancy of the southern shore of the lakes and reaching the supplies at Cleveland.

A few years after the war, Joseph Duncan retired from the army and settled in Illinois. He was soon made Major-General of Militia, and later became a member of the State Senate. While serving in the legislature he introduced and secured the passage, in 1824, of the first law establishing free public schools in Illinois. He was elected to Congress in 1826 as the sole representative from Illinois and remained in the House of Representatives until his election as Governor of Illinois in 1834. He then returned to make Jacksonville his home, building a large house after the model of his Kentucky home and naming it "Elm Grove." He served as Governor for the next four years and advocated many progressive measures, some of them in advance of his times.

The mother of Mary Duncan was Elizabeth Caldwell Smith, the youngest daughter of James R. Smith and Hannah Caldwell. Mr. Smith came to this country as a poor Scotch lad, and by his own exertions became a wealthy merchant in New York City. He married Hannah, the second daughter of the Rev. James Caldwell, who was one of the patriots of the Revolution. The Caldwells were a Huguenot family who fled from religious persecution in France to Scotland, and thence came to Virginia. James Caldwell was a graduate of Princeton College and in 1761 was ordained a Presbyterian minister. He embraced the cause of liberty with intense earnestness, preaching to the troops from the baggage wagons, and sometimes with pistols on his pulpit, so strong ran party feeling in New Jersey. He became a marked man to the British. His wife, a daughter of John Ogden, was shot by a British soldier as the troops marched through Connecticut Farms, New Jersey. She was sitting by her window, surrounded by nine

children and holding her baby in her arms. Shortly after this, Mr. Caldwell was shot by an American sentry who was supposed to be in the employ of the British. The nine orphan children were adopted by friends of the family, General Lafayette taking one of the boys back to France and educating him in his family.

It is easy to realize the earnestness and strong religious views of children with such a heritage. Hannah (Mrs. Smith) was a woman of great force of character. She died when her daughter, Elizabeth, was eighteen. The father having died some years previously, the home in New York was broken up and Elizabeth lived with her sister, Mrs. Matthew St. Clair Clark, in Washington, D. C. Mr. and Mrs. Clark were noted entertainers and in their home Miss Smith met all the most delightful society of Washington. It was at a dinner given by John Quincy Adams at the White House that Miss Smith met her future husband, Joseph Duncan. Henry Clay, who sat next her at dinner, spoke in the highest terms of young Duncan. They were married in 1828 and immediately started for the West. Brought up in the luxurious homes of the East, Mrs. Duncan was impressed by the crudeness and hardships of life in the West, and has left some amusing accounts of her experiences. Later, when she came to live in Jacksonville, she became deeply attached to the people and the life in Illinois. She was a small, frail woman, with intense religious feeling and great refinement of manner and speech. Mrs. Putnam, in the last year of her life, spoke with feeling of all she owed her mother, of the unconscious influence of her simple, perfect manners and strong religious views upon the young, impulsive girl.

The hospitality of the Duncan home in Jacksonville was unbounded. There were no hotels, so all the weary travellers and politicians were made welcome at "Elm Grove." Here, in 1837, came Daniel Webster and his wife, and a great barbecue was held in the grove near the house.

Mr. Duncan was devoted to Mary, who was his eldest daughter, and made her his constant companion, teaching her to ride and taking her hunting with him. Every incident left an indelible impression upon the mind of his daughter, as the days of their companionship were few. Governor Duncan died suddenly on January 15, 1844, when his daughter Mary was but eleven years

old. Later, she never wearied of telling to her children her father's experiences of frontier life and impressing upon them his strong love of truth, sincerity, and courage, and his motto, of which her own life was a constant example, "True politeness is kindly feelings, kindly expressed." Through a correspondence of nearly fifty years with members of her family, no anniversary of his birth or death is forgotten, and the Christmas season always recalled the joyous carols the children used to sing in the old hall at "Elm Grove" and the rapturous opening of the stockings with original toys made by Governor Duncan.

After Governor Duncan left politics, he engaged in many large business enterprises. Unfortunately, he signed the bond of a man who proved a defaulter. This happened just before his death. Had he lived he could have met his obligations easily, but, as it was, a large portion of his estate was sacrificed, immense tracts of valuable Illinois land selling for twelve and one-half cents an acre.

Mrs. Duncan was left with seven children, but she courageously tried to meet every obligation. The family owned a large house and considerable land, which came from Mrs. Duncan's estate and could not be sold until the youngest child was of age, but there was little ready money. During her girlhood Mary Duncan learned to do everything necessary in the economy of a large household. It was in the days when neighbors helped in all times of trouble. We read in one old letter, quite as a matter of course, of the girl of fourteen "sitting up" all night with a friend's child who was ill. Later in life this training was most valuable and she was always a wonderful nurse.

Jacksonville was an unique town. There was a delightful mingling of the best New England settlers brought there by the founding of Illinois College, full of enthusiasm for a simple, intellectual life, and of a small colony of Kentuckians, with their cordial hospitality. It produced a society which has preserved its charm to this day. The fine elm-lined streets remind one of New England, but many of the houses have a distinctly Southern air.

A warm personal friend of Governor Duncan was Colonel John J. Hardin, who was killed at the battle of Buena Vista in the Mexican War. Colonel Hardin, one of the foremost lawyers in Illinois, was able to save the trust fund belonging to Mrs. Duncan's estate, and administered the property so that there should

be money for the education of the children of his friend. The girlish friendship between the two daughters, Ellen Hardin and Mary Duncan, was continued through the many vicissitudes of their lives. It was at the home of this friend, who married a son of Chancellor Walworth of New York, that Mary Duncan met her future husband. Mrs. Walworth is still living in Saratoga Springs and last year spoke of their girlhood in Illinois. School books were a great luxury and one copy sufficed for several girls. There was intense earnestness in all they did. The uncertainties of life in those early days taught them to value every opportunity, and a deep religious feeling, shown in the old yellow letters that Mrs. Walworth still prizes, permeated the simple, healthy life of the girls. It was an outdoor life. The girls had their saddle-horses and rode nearly every day. Both of them, later in life, laid great stress on the benefit, physically and mentally, of this feature of their life.

When Mary Duncan was thirteen she accompanied her mother in May, 1846, on a trip East. It was a serious undertaking in those days. They visited Mrs. Clark in Washington, who lived in a beautiful home on Lafayette Square, opposite the White House. The house is still standing, one of the stateliest of the old mansions. On the corner nearby lived "Dolly Madison," the widow of President Madison. Writing in 1892, from Washington, Mrs. Putnam recalls incidents of her early visit, dinners at the President's and at Daniel Webster's, and the ceremonious life at her aunt's: "Yet all this grandeur did not fill me with a desire for its long continuance, for I remember thinking silently that the freedom of my prairie home was much sweeter. But I was enraptured with Mrs. Madison,—lovely Mrs. Madison! It was a delight to us young people to pay our respects to her very often, when she received us in turbaned cap, with the dignity of a princess, and with the urbanity of a truly loyal American woman. We do not see such a type of womanhood now-a-days. Another pleasant memory of Washington, on a later visit, was watching the sculptor, Mills, who was making the equestrian statue of Jackson now in the park. I was also interested in the finely-trained horse that was his model, which I used to see put through its paces, in the Smithsonian grounds, as I walked across them to my uncle Josiah Caldwell's."

There is a characteristic letter of her's written during her visit of 1846, to her youngest sister, describing a May ball she attended. It shows her keen observation and interest in people even at that early age. She writes: "I was introduced to about 9 boys and 10 girls and I talked to 7 girls that I did not know from Adam." Then, with the naturalness which was always her great charm, she advises her sister to be good, adding, "I am very sorry I was not more obedient to Cousin when I was at home. I would have felt so much better now I am away." She always spoke of this visit as marking an epoch in her life. It aroused her ambition to study and prepare herself to take her place in the world that always interested her. She was ever a believer in travel as a means of broadening one's view of life.

In 1847 came another trip to Washington. Mary Duncan describes the journey in a letter. "We went in the cars to Naples, which was entirely inundated. After spending a terribly long day there, we proceeded on board the 'Prairie State,' the finest boat on the Illinois, and arrived in St. Louis just in time to take the boat for Cincinnati. Every one was pleasant on board, and we had good company within ourselves. . . . A severe attack of fever prostrated me on the second day of our leaving Cincinnati;" but she was better "two days later when we arrived at Pittsburg and took the Brownsville boat. In the stage across the mountains there were many pleasing incidents that occurred that day; but I defer detailing them till I see you face to face. We arrived at Washington Saturday night as usual, but what was our disappointment at finding Aunt Anna Clark breaking up housekeeping and going to board. So of course our visit to her was knocked in the head. We are happily situated with Cousin" [wife of Col. Hamilton of Bladensburg, Maryland]. "There are more negroes collected here than I ever saw in my life." Then comes a characteristic touch: "I have promised 30 girls to write." She was always sociable!

In 1850 Mary Duncan went with friends to New Orleans, where she remained some weeks for a very gay visit with some Caldwell cousins.

Mary Duncan received her school education at Jacksonville Female Academy. The number of studies were few, but they were learned with a thoroughness rare now-a-days. She was for-

fortunate in having for a teacher Miss Lueretia Kimball, now Mrs. Kendall, who came from an Eastern home to instruct these minds of which "neither age nor poverty could blunt their intense desire for knowledge." Mrs. Kendall is still living, honored by her pupils to whom she brought not only love of the best literature, which she read to them out of school hours, but a deep religious faith. Mrs. Putnam attributed much of the success of her life to the high aspirations inspired by the rare personality of her beloved teacher. Mrs. Kendall, in speaking of her former pupil, said it was given to but few teachers to see the beginning, the fulfillment, and the completion of such a full life.

Mary Duncan was graduated from the Jacksonville Female Academy in 1851 and in September visited, with her mother, in Chicago, having entertainments given for them by Mrs. Newberry, Mrs. Kinsie and Mrs. Blatchford. The winter was spent in nursing a beloved sister, Elizabeth, who, in spite of all that devotion could do, died in June, 1852. This loss was followed two months later by the death of Hannah, a younger sister. The family now consisted only of Mrs. Duncan and three children, Mary, Julia, and Joseph. In April, 1853, they went East, visiting Washington, West Point, and Saratoga Springs. At the latter place Mary Duncan met Charles E. Putnam, and they became engaged. Mr. Putnam had expected to practice law in New York City; but as Mary Duncan had inherited her father's strong love for the great rolling prairies of Illinois, and belief in the future of this country, she persuaded Mr. Putnam to visit the West. He located in Davenport, Iowa, in the spring of 1854. They were married December 9, 1854, at "Elm Grove," Jacksonville, Illinois. Mr. and Mrs. Putnam arrived at Rock Island on Saturday, January 9, 1855, too late to cross the river to Davenport. They came over Sunday morning and attended church twice that day. It was characteristic of Mrs. Putnam that she presented her letter to the pastor and was admitted to the First Presbyterian Church the following Sunday. She never wasted any time in indecision. Mr. Putnam was a partner of Judge Mitchell, a prominent lawyer; but the times were hard and their income, for the first few years, of the smallest. The first winter the young couple boarded, and their home consisted of one room. Mrs. Putnam, though she had left a home filled with fine old

mahogany furniture, writes most cheerfully: "You don't know what a beautiful table I have made me, covered with red calico. Charlie and I sit beside it each night and read and sew." This first winter they read Milton's life and works and Addison's works. Mr. Putnam was not fond of general society, but to the intimate friends who knew him in his own home, he was the most genial and delightful of companions. The custom of spending the evenings in reading aloud was continued throughout their married life of thirty-three years. As the family grew, the children brought their work, drawing, models of ships, or whatever it might be, around the large tables, and worked, while Mr. Putnam read from the standard authors in one of the richest and most melodious of voices.

On July 30, 1855, Mrs. Putnam writes of an event fraught with great consequences to Iowa: "The first locomotive that has ever puffed its steam into the State of Iowa has just passed by. You don't know what an excitement there was all along this street, and indeed all over Davenport, last week when the 'Antoine Le Claire' made its first visit. The track is only laid down a little way—that is, five miles now, but not a mile then,—and it is truly an era in the town and state. You see, the engine is named for one of our citizens, and his likeness, cast in bronze, is on either side. This, with a visit from the Indians, has added new life and spirit and something to talk about the last three weeks."

At this time Mr. and Mrs. Putnam were keeping house in a small house on Fifth street between Perry and Rock Island streets. On October 18, 1855, their eldest son was born at "Elm Grove" and named Joseph Duncan, after Mrs. Putnam's father. The next few years were devoted to the care of her rapidly increasing family.

Mrs. Putnam's letters reflect her interest in public events. A letter written to her mother, January 27, 1860, shows strong feeling: "You ask what I think of our country? Read Seward's speech in the Senate—'them's my sentiments;' but still I do not fear war. God is a God of mercy as well as justice. Oh, if each one of us would pray as we ought—lead the lives we ought in all things—God would avert his judgments. Let us strive each to be as peaceable and forbearing with each other as we can. No wonder nations quarrel when families and countries don't agree.

God have mercy on our country, have mercy, have mercy! He is our only help in this our sorest time of need!"

When the war was inevitable, Mrs. Putnam worked with her usual enthusiasm to aid the soldiers. A letter written September 26, 1861, says: "We have established a Soldiers' Aid Society today, and in my absence they appointed me secretary. I feel very incompetent to do my duty to such an office and attend to my little family, but Charlie insists on my taking it and promises to assist me all he can. . . I have almost knit a sock for the soldiers since Tuesday night, by just picking it up when riding, nursing the baby, or giving orders in the kitchen." On February 3, 1862, is the first mention of any lecture entertainment Mrs. Putnam ever undertook. In the light of her successful work of later years, it is amusing to read of the door receipts of a lecture by Dr. Fisher, for the benefit of the Soldiers' Aid Society—certainly a worthy cause—being but \$18, while the expenses were \$24. "But he was generous enough not to let the Soldiers' Aid Society lose that. I had to work very hard to get even this money out. . . I had to see to all things regarding the lecture myself and, depend upon it, I will never have anything to do with such an affair again."

But when Mrs. Putnam's interest was once aroused it was impossible for her not to go on. In February there is a report of a battle and "Mr. Powers has just been here and brought me \$50 from the gentlemen. They raised over \$600 yesterday for the relief of our wounded. I've been out this morning, seeing what I could get. We will have an extra meeting tomorrow and next day, and work all we can. Mrs. Rogers, our treasurer, is sick; Mrs. Newcomb, our president, out of town; so all the responsibility falls on me."

Mrs. Putnam's interest in the Academy of Sciences grew out of the love of her eldest son and was so interwoven with the currents of her family life, that a true picture of her could not be drawn without emphasizing her life as a mother. Her work for the Academy was the outgrowth of a mother's love such as is rarely seen. She herself, in alluding to a proposed life of her father, says: "If you would write little home incidents, some home characteristics, they after all make up the greater part of a man's character and add much to the interest of a history."

Her own letters give the most vivid picture of her life. January 8, 1863, upon receiving the *New York Observer*, she writes: "I read every word of it and all that could interest the children. The red ants seem to take Duncan. Oh, mother! what a luxury to have boys old enough to appreciate what you read to them! I have so much pleasure in watching the development of Duncan's mind. My whole days are spent in instructing, playing with, and keeping the children clean. I sew scarcely a stitch and fear my industry will flag; however, I never was so busy in my life—or more happy." Mrs. Putnam fitted up a school room in her house and for several years taught the older children each morning.

The summer of 1863 was spent in Saratoga Springs. Mrs. Putnam had recently become interested in the works of Froebel and began giving the children object-lessons from nature. On January 11, 1864, she writes: "Duncan astonished his father and me by his questions. I fear to have him learn to read,—still let him say his lessons to me daily. Indeed, I do little else but teach manners, morals, reading, spelling, geography, and Bible from morning till night. . . . I feel rewarded, as I go around and seal the foreheads with a mother's sacred kiss, for all my toil and care, and would not exchange my lot for that of the most idle woman in the world. A young lady visiting here said I had the most delightful home in Davenport. I felt it was indeed the truth."

And again, on March 9, 1866: "There is not an hour I spend with my children, in their instruction and improvement, that I am not triply rewarded. . . . I had 28 to dinner last Saturday. We had our bees robbed one night last week and the boxes broken up and the little helpless things scattered everywhere. I gathered them up next day and was badly stung for my pains. I suffered very much, but could I have saved my bees, I would not have cared. They are all dead."

On February 27, 1864, Louis Agassiz lectured in Davenport. Mrs. Putnam writes of spending the morning in reading about glaciers. It was characteristic of her to the end of her life to prepare herself so as to appreciate and understand any new subject. She availed herself of all the opportunities that came to her. She, with her son Duncan, had the pleasure of meeting Agassiz later at Mr. Hirschl's.

In May, 1863, the family moved to a beautiful country home, "Woodlawn," about two miles from the center of the town, on a bluff overlooking the Mississippi River. The place of eighteen acres was laid out by Mr. Mackenzie, an Englishman, in a combination of lawn and wild woods. Both Mr. and Mrs. Putnam became interested in horticulture, their enthusiasm being shown by the purchase of technical books as well as by the planting of an orchard, garden, and vineyard. Here was founded an ideal home.

Mrs. Putnam led an active outdoor life superintending the garden and grounds, encouraging her sons to be interested in all the affairs of the place. She was their companion in all things. She learned to swim, with five of her sons. For some years Mr. and Mrs. Putnam attended a class in a gymnasium in town, often walking the four miles there and back in the evening. This outdoor life was what gave her the strength to carry out her plans and accomplish her great work in life.

On Thanksgiving Day, 1865, Mrs. Putnam writes: "To one and all the dear ones at home I send greetings on this our first great Thanksgiving Day, the grandest day of thanks our country has ever known; freedom in the letter as well as in the spirit; universal hope and renewed hope and renewed life to our land. Proud am I that I am American-born, proud to have six sons to claim this glorious country as their native land; while my heart swells with pride of land and country, my hands are busy about the ordinary affairs of life; and while my heart yearns over my children and their future, their present wants of bread and butter and clothing press heavily upon me, and I cannot spare the time even to jot down all my thoughts and aspirations for them."

The years passed swiftly in the home life, and in attending to a large household, with many guests coming and going. The surplus of the large garden was sent to friends. Neighbors tell of how Mrs. Putnam would stop and distribute flowers and fruit to the children as she drove to town. There was no pleasure to her in having things unless shared with others. Even in the first year of their housekeeping, in 1855, Mrs. Putnam writes of supplying the whole neighborhood with fresh vegetables from their tiny garden; and again in September, 1872, she writes: "We have so many pears and grapes that I want every one to come and enjoy the place, the fruit, and every thing, while I have so

much. I have entertained, I believe, one hundred people at least this summer, a few at a time."

These years were probably the happiest of Mrs. Putnam's life. She writes in 1871: "I am sitting in my conservatory, surrounded by my beautiful flowers, God's special gifts. . . . Life seems so gay and beautiful."

In 1872 came a terrible scourge of scarlet fever; eight children were ill at one time, and the eighth son, Hamilton, died. This was the first break in the family circle.

The next winter, 1872-3, a printing press was purchased, and the older boys began printing a magazine, *The Star of Woodlawn*, and other papers. A finely equipped carpenter shop facilitated the making of canoes and sailing boats. Theatricals were given during the winter for several years, on a regularly equipped stage, with drop curtain and all the accessories. There were historical societies, where original papers were read every week, a stamp company, and a juvenile savings bank. Everything was done to encourage the children to develop plans and carry them out successfully. The parents believed also in recreation and provided a billiard table, riding horses, and all the outdoor sports. Mrs. Putnam writes, in July, 1873, urging her mother to visit her and "let a little of the full glow of happiness that so fills my heart and life to overflowing flow into yours, and feel the full influence of the buoyant young life that so fills this household."

In the fall of 1873 the eldest son, Duncan, returned from an expedition to the Yellowstone under the command of Captain Jones. It had been thought that the outdoor life would strengthen him so that he could go to Harvard; but he returned with a severe cold, which, during the next winter, developed into tuberculosis. It was the beginning of a long battle for life, lasting eight years. Out of the shadow of this sorrow, Mrs. Putnam came a stronger but an older woman. The gay and joyous note of the letters has gone to return no more.

The letters tell their own story, December 1, 1873: "The Doctor says Duncan is not able to study or go to college for years, if ever. We have talked the matter over deliberately, my husband and I. I feel that we must make every sacrifice to accomplish [his restoration to health]."

January 1, 1874: "Tomorrow night the children will go

through their play of William Tell. Mr. Putnam insists on making the home lively and pleasant for Duncan as long as he is with us. It will be absolutely necessary to send him away from home, and very soon. He had a hemorrhage in the street the day before yesterday, which alarmed us all very much."

January 21, 1874: "I leave Duncan scarcely a moment night or day. His father sits with him sometimes while I do some errands. I don't know what to do with him. If he sits still he reads Huxley and Darwin and all the other brain-splitting books you ever heard of—says histories are almost as heavy and stupid as novels. He was actually relieved when we were through David Copperfield. I suppose while he lives he will work."

January 30, 1874: "Duncan is anxious to go with Dr. Parry to Utah next summer, as it is on the desert and near the mountains, so he can catch all kinds of bugs. Oh, that God would spare his life that he may fulfill his great promise. . . I've been setting type to-day. George and I run races which can distribute the fastest. I am learning lots about printing and becoming fascinated with the work."

February 4, 1874, a letter to her mother: "Duncan has been very ill. I have had no heart to write. To-day he is back in his bug room which makes him and me more cheerful. This is the fourteenth hemorrhage in six days. I have not left Duncan a moment day or night; how long I can hold out I don't know. Pray for me and mine, dear mother.

"Your loving child, .

MARY."

February 15, 1874: "Yesterday I took Duncan to spend the day with Mr. Pratt; he afterwards went to the Horticultural Society, and they made him Secretary pro tem. I went up for him there. He was such a boy, writing the minutes of the meetings, surrounded by gray-headed men. He the only child in the midst and doing the hardest work. However, it interested him and I cannot see that it hurt him any."

March 5: ". . . I have been setting type to-day, so has Duncan. The boys have printed off my piece—I set every word of it myself."

On March 18, 1874, the eleventh child and tenth son was born. A few weeks afterwards, when Mrs. Putnam was driving with her son Duncan, the horse became frightened and ran. Mrs.

Putnam was thrown out, striking the sciatic nerve. She was unable to move for weeks, and never fully recovered from this injury. In September of this year she joined her son in Colorado. A month was spent most delightfully in camping in a log cabin at Empire City. Five children were with her and five were left in Davenport. Two botanists, Dr. Engelmann and Dr. Parry, were collecting in the mountains. They, with their wives and Mr. and Mrs. Ballord of Davenport, made a pleasant party that gathered nightly around the fire of pine knots in the cabin.

Mrs. Putnam returned home in September, leaving Duncan to spend the winter in Cañon City. During this winter Mrs. Putnam read all his lessons to her third son, John, whose eyes began to trouble him. It was through her eyes that he was enabled to graduate with honors from the High School. One wonders where she ever found the time to accomplish all she did. Her household cares were always arranged so that there was time to be with the children, when out of school. She had the great gift of realizing what was the most important thing to be done. She wasted no time over the non-essentials.

On February 4, 1875, comes a record of the first effort to raise money for the Academy of Natural Sciences, the beginning of almost exactly twenty-eight years of work for the association. At the time Mrs. Putnam was forty-three years old, the mother of ten living children, and with the multiplied cares of a large family and a wide social circle, she would have been entitled to retire from active work. But the voice of her eldest son, an exile for his health, came to her, urging her to do something "to make the Academy popular." She writes to a friend, speaking of one subscription already received: "If all the patrons of the library were as liberal to the Academy, I will not have more to do to get my \$500 than I can do with my hands thus tied with my sick children. Why should not the two institutions work side by side and be one in spirit as they are in fact, each struggling for the advancement of knowledge in our midst, each helping on to the investigation of truth, could they not be made a crown of glory to our town?" A hope which is at last being realized.

On February 11, 1875, her youngest child, Berthoud, died. This loss was deeply felt by Mrs. Putnam. She writes of how

empty her life seemed, the first time for twenty years that there was not a baby in the house, to be the first consideration. Those who knew Mrs. Putnam can see how naturally grew her interest in the Academy, which she would sometimes laughingly call her twelfth child.

Mrs. Putnam was elected a member of the Davenport Academy of Sciences June 2, 1869, at the same time her son Duncan, a boy of thirteen, was elected. He had been interested in the Academy almost from its beginning and insisted that his mother must become a member at the same time. She was the first woman member. The Academy had been organized on December 14, 1867, by four men. The meetings had been held in various offices until, in 1868, a "very liberal offer was received and accepted from the Young Men's Library Association to have the Academy deposit its cabinet and hold its meetings in the Library rooms, corner of Second and Brady streets." It may be noticed that the singular noun covers the extent of the museum. Here the "cabinet" remained in a dark corner until the fall of 1872, when the meetings were held for some time in the law office of Putnam & Rogers. Mrs. Putnam never made any pretense to being a scientist herself, but she frequently accompanied Mr. Pratt and Duncan on their Saturday excursions for shells and insects.

In March, 1875, Mrs. Putnam, assisted by other ladies, furnished the bare Academy room with matting, shades, and cases. A letter of June 2, 1875, to Mrs. Parry, tells of further work: "Duncan and I attended together the Academy meeting the other evening. . . There was a large attendance, and Duncan seemed wonderfully pleased with the looks of things and the large donations sent in. . . I presented eleven ladies' names [for membership] the other night; this will make twelve. The cases look so nice, and many other things are waiting to be arranged; Duncan's collection fills one-half a case." Then, with a prophetic look to the future, she continues: "I wish we had a fire-proof building. . . I wish the Doctor could induce some of those rich societies East to send us \$1,000 as a nest egg to secure some property here for that purpose; now while the enthusiasm is freshly awakened we must not let it die out until something is done. I like the plan of endowing the institution so as to secure some one to spend all of his time there, making exchanges, etc."

On September 2, 1875, Mrs. Putnam writes: "Duncan thinks the Academy has at last done something in that it has sent Dr. Farquharson to Detroit. Well, I, too, have found a new interest in the Academy in that it has resolved itself into a Home Missionary Society. There is an old man, Captain Hall, very much interested in the Academy, who goes up and down the river in his boat every day and he has a locker in there filled with Sunday School books for the little children all along the shore, and when they see him coming they run down to the shore with their stone axes and arrows and give them to Uncle Hall—so he brings in many things every few days to the Academy, and for these he has distributed 460 books to the children in the last three months. Now, my dear mother, where can you find a nobler work? All the parents of these children are going to visit the Academy thro' Fair week and we expect to interest them to bring in many more things," a hope which was realized, for on October 31st there is mention in a morning paper of a long list of donations to the Academy. For years afterwards Mrs. Putnam collected Bibles, old school books, illustrated papers, money, and groceries to give to Captain Hall. It is largely due to his efforts that the Academy has one of the finest collections of Mound-builders' relics and ancient pottery from the Mississippi Valley.

The country was deeply interested in the Centennial celebration, which was to occur in 1876. Women were urged to send samples of their handiwork to the "Woman's Pavilion" at Philadelphia. The enthusiasm of the women of Davenport was diverted into a new channel, which has had ever widening influences and has been of inestimable benefit to the town. We read of the beginning of the Centennial Association in a letter from Mrs. Putnam to Mrs. C. C. Parry, written September 17th, 1875: ". . . We had a most enthusiastic meeting yesterday of the ladies. I was so tired last night I could not sleep, what with shopping, making calls in the morning, arranging about my grapes, sending to Rock Island for the young ladies, having them to tea, going up immediately after to a lecture on the Mind . . . I wonder I don't feel more tired today, but I don't. Our Academy rooms look lovely. Mrs. Silsbee, Mrs. Price, and Mrs. Clark sent flowers. . . . It seems to have been well understood that the meeting was called in behalf of friends of the Academy and most

noble was the response and enthusiasm. Mrs. Potter took the chair, and I made a speech about the necessities of the Academy, and its great work. I think it was a little 'stumpy,' but upon a vote being taken whether such an organization for the Centennial, having the Academy as its legitimate finale should be had, a most enthusiastic 'aye' was responded. . . . About 30 ladies were present." The effects of this meeting were far-reaching in the history of the Academy. The Ladies' Centennial Association published the first volume of Proceedings.

We can realize the interest women were taking in the Academy when out of a list of eighty-three new members this year, we find forty-three were women, all personal friends of Mrs. Putnam, so it is not difficult to see how their interest originated. She was succeeding in "making the Academy popular."

On November 26, 1875, J. Duncan Putnam introduced a resolution at a meeting of the Academy to publish the Proceedings, giving the following reasons: "1. It will preserve much material that might otherwise be lost. 2. It will furnish greater incentive to our members to make original investigations. 3. It will increase the library by means of exchange with other societies and publishers. 4. It will place us on a creditable footing with the other societies of the world." It was voted to publish them, and on December 20, 1875, the offer of the Ladies' Centennial Association to print the Proceedings was accepted by the Board of Trustees.

To raise the money necessary was a serious undertaking in those days. We read in a letter of Mrs. Putnam to Mrs. Parry, December 29, 1875: "We want to have a grand entertainment the 22nd of February; hope to make \$200 clear. I have been successful in raising, from the Academy gentlemen mostly, the sum of \$183 for publishing fund. I promised \$200. . . . I have had some amusing experiences in studying human nature this winter and am more astonished than I can tell you at opposition to this project from sources little expected. . . . The Academy men are working right hard to get their Proceedings ready. We want the book to be Centennial and worthy our city. . . . Nothing but the publication keeps him [Duncan] alive. He and Mr. Pratt visit the engravers, go after the drawings of axes, flints, arrowheads, etc. He gets up town to the Academy rooms every

day, most always twice a day. There are more visitors there in one day now than there used to be in weeks."

On January 8, 1876, Mrs. Putnam writes: "We had quite a meeting of our Centennial ladies who are to appoint committees for our next entertainment on Monday next. I get out of all these duties by raising \$200 from the members and others. . . . The ladies voted \$100 of their money and are going to raise money to the amount of \$600, with my \$200, and assume the publication. We have a board consisting of Mrs. Magonegal, Mrs. McCullough, Mrs. Sanders, and myself to look after the publication; having already, (or rather Duncan and Mr. Pratt have) received offers from several engravers and publishers; and we can have about 25 pages of engravings and wood cuts for about \$200. . . . Let our Centennial issue be worthy the name."

February 9, 1876: "We are having a lively time over committee meetings, etc., . . . and lots of nice things are happening for the Academy every day."

The Centennial Association planned an elaborate series of entertainments to raise the sum of \$600. The first entertainment on February 22, 1876, was very successful; but in the early hours of the following morning the building in which it was held was destroyed by fire, occasioning losses of about \$1000 to persons who had loaned articles for the entertainment. The association felt bound to repay these. The first pages of the Proceedings have been started, but the Academy, on February 25, passed a resolution of thanks and sympathy and suggested the postponing of the publication. The women courageously refused.

On March 10, 1876, Mrs. Putnam writes: "We undertook a great enterprise and have done wonderfully well indeed. I never heard of anything like it. We have raised at least \$1500 in a little over two weeks; paid off our debt, and have on hand \$365 for our book. I have devoted hours every day to the work and hope my labors are over."

March 17: "I have been led into more public life than I think either agreeable or necessary of late and feel very happy to retire into private obscurity of home again. I attended the last meeting of our Centennial Society Wednesday, and audited all the accounts. In three weeks we have raised enough money to pay all debts incurred by the fire, \$1000, and have \$450 left in the bank for

publishing our book. The citizens have expressed great sympathy and done a great deal for us. I shall devote myself to my garden this summer." She also writes at this time of reading his lessons to her son John, for three hours a day, and to the children two hours every evening. An old list, kept by one of the children, shows an astonishing array of books read to them by Mrs. Putnam:—histories, travels, Scott's novels; and four times did she read aloud to successive groups of children the unabridged edition of Robinson Crusoe, not omitting the religious discourses.

March 27, 1876, Mrs. Putnam writes to Mr. Parry: . . . "If you have received the late dailies you must be pretty well posted as to what all my outside life has been these last busy weeks, but they tell not half the story; how through discouragements we have come out victorious. Even fire could not quench our zeal, and never for a moment have I felt with some that we must postpone our work of publishing. . . . They are thinking of forming classes in the Academy and letting those interested in special subjects meet together and report to the Academy. Duncan is urging this very much, and will take the chairmanship of the zoölogical department. . . . You never knew anything like the warmth and sympathy every one has expressed for our misfortunes." The Bric-a-Brac Club gave a loan entertainment which helped materially to pay the debt caused by the fire.

In August of this year Baron Charles R. von der Osten Sacken, a distinguished Russian entomologist, visited "Woodlawn" to meet the young entomologist, Duncan. He has been an honored friend of the family ever since and has contributed a scientific paper to this Memorial volume. He was one of many who showed their appreciation of the remarkable work done by the invalid boy, self-taught, working out his ideas alone in this Western town, far from the influence and help of college or museum. His work was done with such thoroughness that to-day, after a lapse of twenty-five years, it is still the authority in the lines of work he took up.

In September, 1876, Mrs. Putnam and her son took the first copy of the Proceedings to Philadelphia and placed it in the Pavilion at the Centennial as a sample of woman's work in a Western town. They then went to Washington, where Professor Henry,

Secretary of the Smithsonian Institution, became so interested in the work of the Academy that he placed its name among the first on the list of foreign exchanges for scientific books. On October 14 the Publishing Committee of the Ladies' Centennial Society reports "Vol. I. published by them, as now complete and placed at the disposal of the Academy." Nine hundred and ninety copies were received; two hundred and fifty were distributed to subscribers and four hundred and fifty-six to the scientific societies. The volume received praise from all parts of the world from those interested in the progress of science.

A rather detailed account has been given of the publication of the first volume, because it was a unique enterprise for women and also because it accounts for Mrs. Putnam's future interest in the publication, an interest that continued through her life, and by her endowment will go on in perpetuity.

At the urgent solicitation of Mrs. Putnam, a few months later, on February 22, 1877, her old friend, Mrs. Patience Veile Newcomb, gave a lot on Brady Street to the Academy of Sciences, "To show my appreciation of its worthy objects and because of the great regard I entertain for my young friend J. Duncan Putnam, and my admiration of the noble work he is doing in its behalf." Plans to build were at once commenced. Mrs. Putnam and Mrs. Sanders were elected on March 6, 1877, a committee to procure subscriptions for a new building. The required amount was raised by Mrs. Putnam, Mrs. Sanders being unable to act.

A "Kettle Drum" entertainment was given in July, 1877, at "Woodlawn" by Mr. and Mrs. Putnam for the benefit of the Academy. Between seven and eight hundred people were present. It was a perfect summer's night, and it was the most successful fête ever given for charity in Davenport. The amount realized, eight hundred dollars, was so encouraging that two days later the committee on building reported in favor of erecting "a plain and unpretentious edifice, sufficiently large for the present needs of the Academy but not so large as to leave it in debt."

The corner-stone was laid on October 4, 1877, and on February 22, 1878, a year from the gift of the lot, the new building was opened to the public. There were on exhibition an art collection, copper implements from Wisconsin, eight microscopes, and

a beautiful collection of butterflies. Though the admission fee was but twenty-five cents, the net proceeds were four hundred and fifty dollars. The Ferry Company, through the interest of Captain Robinson, a lifelong friend of the Academy, carried all ticket-holders free from Rock Island, which shows the universal interest felt in the starting of this little institution.

In January, 1878, an Art Association was organized and held its meetings in the Academy building. The society existed for several years, holding a number of exhibitions. It was always an earnest desire of Mrs. Putnam's that the fine arts should have a place in the Academy's work, and that the Academy should be an institution for the broadest culture.

On August 4, 1878, there is mention of future work. "I have had the circular room in the basement finished; it does look so beautiful, and will give us room for all the curiosities we can collect. I have had the lathes, nails, and sand given to me, and I had enough money in the bank, left from the festival, to pay for the work; so now I have accomplished what I started out to do" (a statement true of her whole life). Mrs. Putnam often spoke of laborers volunteering to give a day's work to help build this institution, and took pride in the development of the Academy from such small beginnings.

Mrs. Putnam was elected President of the Academy on January 1, 1879. It was an honor she always deeply appreciated. Dr. Parry, in nominating Mrs. Putnam as President, said: "It is quite unnecessary to explain to any one here present that the actual success and present prosperity of the Academy has been coincident with the interest taken in it by women. It was a Women's Centennial Association that first inaugurated and successfully carried out the publication of the Proceedings, on which more than on any other one thing the scientific character and standing of the Academy abroad has been firmly established. The very ground beneath our feet is the spontaneous gift of a generous woman and this commodious building, which affords us a permanent home, from lowest foundation stone to highest roof-crest, if not the direct work of woman's hand, has been wrought out and completed under the inspiring influence of woman's heart."

The years were full of busy plans to raise money for the Acad-

emy, of which we have no record, except the occasional mention in the Proceedings of the proceeds of a lecture or entertainment. An unfinished letter which survived the destruction of "Woodlawn" gives a picture of what work these entertainments entailed. It was written just after a concert given by Sherwood on May 23, 1879: "From day to day I haunted the editorial chairs, buttonholed the local editors, made journeys to Rock Island and back again, had tickets printed at one office, placards at another, and the programmes at a third. These tickets I was very judicious with, giving some fifty to the editors, and about as many more to music teachers and those promising to interest their pupils. The placards I took to Rock Island, left them with a friend who saw four of them put in the street cars. (We sold four tickets in Rock Island). . . . The other placards I took in my buggy and put in front of windows, and sent John to street car lines to have others put in cars. This was no small part of the work, for the next morning after leaving them they did not appear; so I had to see first one driver and then another about it. At last Sherwood was fully understood to be coming. You could not lift your eyes along the principal streets that 'Sherwood, the greatest pianist in America, Burtis Opera House, May 23,' did not meet your eye. These immense placards haunt my memory. Then the programmes: how to get them up was at first a mystery to me. . . . They were to be dainty and unique. . . . The 'opinions of the press,' which the agent sent me, had been placed in the hands of the local editor to make extracts from day by day, and which by the way he never used. Now, you must know our 'City Local' is a hard man to find, as he sleeps all day and writes up his locals at night. After many delays the programmes came out, 1000 of them. My presence with the old blind pony on the street corner seemed to be the sign for the gathering of all the musical men, and I would hardly have stopped before they would flock around the buggy and talk over the prospects, and one after another would start off to find some enthusiastic person who needed only to be told about Sherwood to bring in a dozen men." The letter lies unfinished. A few days later, May 27, came news of the death of the third son, John, at an Eastern college.

In her annual address, read January 7, 1880, Mrs. Putnam regrets that she had not been able to do more work for the Acad-

emy, on account of the great sorrow that had come to her; she speaks of the afternoon talks given by Mr. Pratt, Dr. Parry, and others, and adds that "the familiar lectures and classes have been established with a view to secure the interest and coöperation of the pupils of our city schools. If the results in this direction have not as yet proved all that could be desired, or reasonably expected, it is still a matter of congratulation that at least some earnest efforts have been made to place the Academy on its legitimate basis as an educational institution." In the spring Mrs. Putnam had arranged a botany class under the direction of Dr. Parry.

Thus was inaugurated a movement which Mrs. Putnam and the other workers in the Academy had had in mind for years: the teaching of the school children natural history in the Academy. This work was carried on from time to time by Mr. Pratt. It is gratifying to know that twenty-three years later, just before her death, Mrs. Putnam had the deep happiness of seeing this movement regularly organized and the children coming by the hundreds, to the Academy to study its collections and receive systematic scientific instruction.

These were anxious years, watching over the failing health of her eldest son. Mrs. Putnam accompanied him on his short trips, one being to Des Moines in 1881, in the endeavor to have a state entomologist appointed for Iowa. What is now regarded as an economic necessity was then regarded as a most visionary extravagance. Of her visit to the legislature Mrs. Putnam writes: "It recalls the days when I heard Clay, Webster and Calhoun, in Washington; a little different, it is true, still the same feeling came over me."

The publication of Vol. II of the Proceedings was the individual enterprise of J. D. Putnam and was begun in February, 1877. One result of the publication was to bring in large numbers of scientific exchanges. Mrs. Putnam writes in August, 1878: "Our library has gotten a great start and is filling up very fast. We have put the books up in the Art room, and they set off the room beautifully."

No sooner was Vol. II completed than Vol. III was started under great difficulties. The amateur printing press was moved from "Woodlawn" to the basement of the Academy; and here the typesetting and proof reading was done in the most economical

manner, most of it by J. Duncan Putnam. Out of such sacrifices grew Vol. III.

At page 128 of the volume the labors of J. Duncan Putnam ceased. He died on December 10, 1881. He was one of the sincerest seekers after the truth, gentle, modest of disposition, entirely forgetful of self in the enthusiasm of the aim in view. He had crowded into his brief span of twenty-six years the work and enthusiasm of a long life. To the mother who had watched over him for eight years, who had been his comrade in every enterprise, who had built up the Academy for the sake of bringing a bright look on the wan face of the invalid, to her his interest in the Academy descended as a sacred legacy.

Naturally, Mrs. Putnam's work in the Academy went on. On January 27, 1882, she was appointed Chairman of the Publication Committee to succeed her son. From this time until her death her interest in the publication never lessened. The year was spent in arranging the papers of J. Duncan Putnam. With the assistance of Prof. Herbert Osborn his scientific work was completed and published in Vol. III, which was appropriately made a memorial volume.

On October 29, 1882, Mrs. Putnam writes to her sister, Mrs. Edward P. Kirby, Jacksonville, Illinois, "I sent you sheets of the Memorial Volume for my gift. It is more than gold to me, the perpetuating the memory of such a boy;" and a little later: "I am so happy in this glorious work of my beloved son. I wonder if any one ever did so honor and love a boy. God bless his precious memory!"

In April, 1883, a special meeting was called, and an effort was made to raise the indebtedness of the Academy. Not only was this done, but over \$1,000 was left as an endowment for the institution. The credit of this undertaking is due especially to Hon. George H. French, Major George P. McClelland and Mr. Nicholas Kuhn.

Mrs. Putnam attended the meeting in Minneapolis of the American Association for the Advancement of Science in August, 1883, renewing and forming friendships with Eastern scientists and interesting them in the Academy. Professor F. W. Putnam visited Davenport from Minneapolis and gave a lecture for the benefit of the Academy. The visit of Professor W. H. Holmes at

this time was followed by an offer to write a paper on the pottery contained in the Academy museum, the Smithsonian Institution to furnish the plates to illustrate the paper. This is the most valuable paper ever printed by the Academy on the pottery in its collections. The generous offer was gladly accepted, so Volume IV was started with the sum of only \$72.37 on hand, and unpaid subscriptions amounting to \$51.

Entertainments helped to meet the expenses of the Academy. Courses of lectures were successfully given; the annual children's entertainments on the twenty-second of February were never by any chance omitted; an extensive exhibition of English water colors proved a great success both artistically and financially. All these undertakings and many others, of which space will not permit the mention, testify to constant, busy work on the part of Mrs. Putnam. There were hours of grief which were silently hidden from her immediate family, but which a stray letter reveals. She laments writing a sad letter the day before, to her sister, "but how can I help it; now and then I feel I must cry out in agony, but to-day I determined to work, work again for the beloved Academy, and so I get me to work."

In 1885 a salary of \$500 was voted for Mr. Pratt as Curator. He had given all his spare hours, from the beginning of the formation of the museum, to arranging the specimens, and had been a most faithful worker. All the work in the Academy previous to this time had been verily "a labor of love." As usual Mrs. Putnam raised the money, assisted in part by Mr. E. P. Lynch.

June 9, 1885, Mrs. Putnam writes: "The Horticultural Society offered the Academy strawberries and cream for a festival. I have all the management and responsibility. I rather shrink from it, quite different from a few years ago when such a thing was fun; especially as I have all of the profits for my publication. Mr. Holmes' paper is done, and I have to pay out \$100 right away and have not one cent." After the entertainment was over, on June 22, she writes: "I have given a most successful and brilliant Academy festival—a decided success—a large crowd of people—superb music and strawberries (150 quarts were given me, all the cream, flowers, etc.). I took in \$70; some necessary expenses took my profits down to \$60. As I had to meet a bill of \$144, it helped me that much and encouraged me to attempt another."

The Davenport Chapters of the Agassiz Association were formed about this time. Mrs. Putnam was naturally much interested in their meetings at the Academy and often attended them, reading to them from "Walks Around My Garden" and other books. They frequently spent the day at "Woodlawn." Mrs. Putnam always wanted the children to come to the Academy. She writes: "The lot was given on the twenty-second of February; the building dedicated on the next twenty-second; children entertained the next, and every year this has been our 'Saint's Day.' We expect 500 children" [at the entertainment she was planning]. In the summer of 1886 the National Convention of the Agassiz Association had a most successful meeting in Davenport; over one hundred delegates were entertained.

April 2, 1886, she writes: "Printers do go so slow [all of Vol. IV not finished]. Yet I have commenced another, Vol. V, and have eight pages printed; but a gentleman has given us such a splendid paper to be fully illustrated, and so many of our members subscribed at once, that I am not going to have the same trouble with Vol. V. It is just splendid, too, that our publication goes straight on. As soon as one volume is done another begins, and once in three years we bring out our latest thought. Vol. IV is making for us a splendid record—so I think one thousand more books will come into our library this year. Two thousand came last year. We have to-day received a beautiful collection of shells and minerals. I attended a meeting for birds this afternoon. It is dreadful, the slaughter of the innocents. I visited seven ladies, all of whom promised to take them off their hats. Fifty ladies signed a paper for the same." Never afterwards would Mrs. Putnam wear aigrette or wing in her bonnet.

There always was need for money, and on July 13, 1886, another lawn fête was given for the benefit of the Academy, at "Woodlawn." Mrs. Putnam writes on June 14th: "It will be about nine years since my last 'Kettledrum,' and that is still remembered by everyone. Great changes have occurred in my home since then. . . . When I think of all I have lost in these nine years my heart shrinks from the effort, but it must be done. I must work to live; the Academy must have money, and who will give it to us? So I am bound to go through with it. This 'Mid-Summer's Night's Fête,' as it was called, was successful in every way.

Mrs. Putnam was most modest about her own abilities. On October 17, 1886, she writes: "I was much interested in your account of the robins. I am sorry I have not studied the habits of birds and animals as I would have done had I been a woman of leisure. But the fitting of these young lives to cope with the world, the impressing their natures with the love of truth, and forming their characters for noble aims, has been the engrossing work of my life, and the little I have done for the scientific world is to oil the wheels of this institution by getting money to carry out the scientific thought of my beloved son Duncan and his associates. His monument he builded himself. God grant it may grow more worthy of his noble life and as years roll on take the hold of the people his sacrifices entitle it to."

It was felt that there should be some permanent basis to pay the salary of the curator, besides a yearly subscription and the dues of the members, so Mrs. Putnam reported to the Board of Trustees, on November 25, 1886, a plan to "raise an annual subscription of \$400 a year—for five years—to provide for the support of the Academy and obviate repeated appeals to the public." This plan received, according to the Proceedings, "the approbation of the Trustees," and Mrs. Putnam was appointed to raise the amount.

The old subscription paper is still preserved, the worn edges testifying to the faithful service it did as it made its yearly rounds. The mute signatures tell little of the part they played in tiding the Academy over the most critical part of its history. Many of the early enthusiastic members had died; there was little interest felt in the institution by the majority of citizens. No one knows the number of times Mrs. Putnam was advised to close the doors and simply let it die. The subscription paper stands a monument to her indomitable perseverance and courage.

Of the efforts to raise this money Mrs. Putnam writes to her husband on December 10, 1886: . . . "Oh, that I could know some of the mysterious joys of a true scientist and a true artist, but I don't believe it was meant I should classify or arrange anything unless maybe a subscription paper; this I have done of late to my great satisfaction and have more than one-half of what I expected pledged for the coming year of the Academy. . . and then if they sign for five years they may some of them remember

us in their wills—anything we give to for five years we love, you know; and if we tide our beloved son's Academy over these five years, as we have the last since he left us, I really think it will be taken care of, don't you?" And again on January 2, 1887, to her sister-in-law, Mrs. Mary P. Bull: "\$350 a year has been subscribed without much effort. I shall hope to get at least \$400 before another week, but I have been too busy sewing to attend much to other matters. . . . I often wish I were rich. I would never see that boy's institution suffer for the want of so little; but it will be endowed some day; and his name will live as it ought to live when marble monuments have perished and monumental fortunes have crumbled away. The memory of my beloved Duncan will live for ever in the hearts of all who knew and could appreciate his gentle, quiet, and scientific nature. It is five years since we laid him away, but oh! how his presence haunts my dreams, how often I think of him and long for the touch of that vanished hand."

The last \$50 of this subscription was raised by Major McClelland for Mrs. Putnam, who was ill at home, but who writes on hearing that the entire sum was raised: "I never felt more happy than to-night for I feel sure now the Academy has a future."

On the morning of June 3, 1887, the beautiful home of "Woodlawn" was destroyed by fire. None of the family were at home. Mrs. Putnam was in Chicago. It was decided to camp out for the summer in the gardener's cottage on the hill. Both Mr. and Mrs. Putnam took up the readjustment of their household in the changed surroundings, with their usual quiet courage, Mrs. Putnam making a cosy home with the few things saved from the fire. She lamented the loss of the drawings and writings of her son Duncan, and of Mr. Putnam's unpublished literary papers, the work of a lifetime, but she felt that as long as the family circle remained unbroken, there was a bright side to the disaster. This comfort was soon taken away, as six weeks later, on July 19, 1887, her husband, Charles E. Putnam, died after a short illness.

Mr. Putnam was a man of strong personality. He had been a prominent lawyer, President of the Davenport Savings Bank for fourteen years and had written the Savings Bank Law which was adopted by the State of Iowa, and is still in force. He was

President of the Gas Company, the Plow Company, and of numerous other organizations. He had infinite tact and a wonderfully quick mind that grasped the essentials of a subject at once and enabled him to carry on so many and varied lines of work. He had a strong love for literature and accumulated a large and well selected library. His leisure hours, for years, were spent in literary work. He followed his children's occupations with the same interest as his wife, and through his son Duncan became interested in science. He was President of the Davenport Academy of Sciences in 1885 and 1886, on its finance committee for years, and trustee for fourteen years. He was a man of broad sympathies, and every good work received support from him. Much of the work that Mrs. Putnam accomplished is due, no doubt, to the encouragement and sympathy she received at home.

Their married life of thirty-three years had been so congenial and ideal that his death would have been a deep sorrow at any time, but especially so after the loss of their home and with the uncertainties of the future. After a few weeks the widow, left with six sons and one daughter, roused herself from her grief and writes to her sister: "The work of life must go on; these dear children must be helped to maturity. I have made up my mind to go to town each day and do my duty for my children." In the fall of this year the family moved to a house in town, where Mrs. Putnam lived the remainder of her life.

The next winter she interested herself to see that the salary of Mr. Pratt, the faithful curator, was paid.

Mrs. Putnam and her daughter sailed for Europe October 3, 1889. On the morning she left Davenport, Dr. C. C. Parry, ever a staunch friend of the publication, brought the last sheets of the Proceedings, still wet with the printer's ink, to the train, where other members of the Academy gathered. It was the last time many of the old friends met.

The trip abroad was prolonged beyond the original plan on account of Mrs. Putnam's poor health. She took an intense interest in everything abroad, especially the customs and life of the people. She had painted in her younger days, and always had an instinctive taste for the best in art. The galleries were a constant source of pleasure to her. She visited the museums, and was delighted when she found the Proceedings of the Academy

in the libraries. She had a great gift of attracting people to her and everywhere made warm friends. She was the most delightful of travelling companions, and could relate her experiences in a lively, vivacious manner. She was rarely gifted as a conversationalist. As a friend remarked, they would hear something interesting when Mrs. Putnam returned, not of the trivial discomforts of the journey.

This was her longest trip away from home. From girlhood she had been a frequent traveller, enjoying the opportunity to see things and even more to meet people. But she never forgot the interests of home. Mrs. Putnam writes from Paris, in May, 1891, just before sailing for home: "The more I see of this life abroad the more I am convinced the true life is at home and the greatest glory of a woman is to grace her own fireside." As soon as she arrived in New York she writes: "Home! oh, you never can know what that word means to one unless you have been away so long. All America seems home to me—now I have touched my native land, I am perfectly happy."

She missed many old friends upon her return to Davenport. Dr. C. C. Parry, who had been closely associated with her son, Duncan, had died; Mr. Pratt had removed to Minneapolis, where he died two years later. Dr. Barris, one of the few of the old members left, had been appointed curator.

Mrs. Putnam was just in time to start a new five years' subscription paper. On December 18, 1891, she writes to Mr. Pratt: "I have taken up the role of presenting the \$400 list to my friends in behalf of the beloved Academy—shall I call it a success? In about three weeks I have \$300 on the five years' subscription, from 1892 to 1896, and \$60 on this year . . . but I shall have to wait a little while until I recover from a refusal from —— and a very few poor men like him! It will do me good to wait and consider, it was such easy sailing. People met me more than half way. I own up I went first to the old and tried friends of the Academy. . . . We owed the curator \$300 when I came home; by January first I think we can almost pay last year's salary, but oh, we must get enough to keep him next year, and next, and next, for five years, and then the \$120 for the Index—we must have that, you see . . . and then the binding and distributing! will we wait forever for the endowment! . . . I wish I could do something in

my small way to make the annual meeting a worthy meeting, worthy the spirit of the past. What an interest we used to feel, what palpitations of the heart lest all the reports should not be up to the standard. What a full life we are leading, and how little we know it."

Four times did Mrs. Putnam secure this assured income to the Academy; the last time in 1902, the year of her death. This was for a larger amount, eight hundred dollars; and by this means the Academy was enabled to secure the whole time of a curator, and started on its new era of prosperity. Once when a friend had spoken to Mrs. Putnam about leaving something to the Academy, she wrote: "I wish he would just give it now and spend it himself." She was ever eager to see immediate results.

On November 23, 1892, there is a letter to "My dear friend Mr. Pratt: Do you remember the long ago—when the spirit of unrest drove me to make a commotion in the dear old Academy building, and desks and cases were moved, and decorations were hung—a piano brought in, and flying feet did the work of busier brains, and all was commotion for one day or two and disorder for a week or so afterwards, at least you and Duncan used to declare you could find nothing. . . . Well, I have been strongly reminded the last month of these dear old commotions and upsets, yet with many differences. Then the object was always to make some money—now it is alone to spend it; then the movement and stir was witnessed by loving eyes who followed in sad disapproval, with a lurking smile of satisfaction at the known results; now no loving eye has followed—no helping hand has lifted itself—no laughing, warning voice has been uplifted that this must be the *very last* entertainment in the Academy. Alas, the last gatherings there have been funerals, and the stillness of the grave has followed my lonely steps as I have plodded along. . . . I have only touched on the outside of it all [in the cleaning]. I feel as though I had lived over twenty years in this month. . . . I have put Prof. Starr's paper in the printer's hands Monday of this week—made the same bargain as for Vol. V; and while there is not a cent to begin paying the printer, I have faith that by the time the first form is printed the money will be forthcoming."

This cleaning was preparatory to the celebration of the twenty-

fifth anniversary of the founding of the Academy. The day before, on December 13, 1892, Mrs. Putnam writes, "I'm so sorry I undertook the Academy entertainment just now, but a twenty-fifth anniversary does not often occur. The weather is beastly, yet I have to go out in it for the last things. Think of us to-morrow." That afternoon Mrs. Putnam was injured in a fall from a street car and was unable to go to the entertainment. A few days later she writes, "I love the Academy better to-day than when my dying boy almost breathed its name with 'Mother' from his parting breath—it was his legacy to me. When I thought I was killed the other day I was glad that the Academy had a new coat of paint on it. . . My back troubles me some. I think almost more than at first. Yet I go out every day and try to think I am not hurt."

At this time Mrs. Walworth, one of the founders of the Daughters of the American Revolution, induced Mrs. Putnam to become the first State Regent of Iowa.

In 1895 Mrs. Putnam was left a bequest by her sister-in-law, Mrs. Mary Putnam Bull of Tarrytown, New York, of the sum of ten thousand dollars, "as a memorial to my brother, Charles E. Putnam, and my nephew, J. Duncan Putnam." It was Mrs. Bull's idea to have part of it used in erecting a monument in the cemetery. Mrs. Putnam placed a large glacial boulder, found on the banks of the Mississippi, to mark the resting place of these two men of simple tastes. The inheritance tax of the State of New York was five hundred dollars and Mrs. Putnam gave the remainder, nine thousand five hundred dollars, to the Academy, establishing the Putnam Memorial Fund, the income to be used toward carrying on the publications of the Academy. No more fitting memorial could be found in view of the long and intimate association of father and son with the Academy.

Previous to this time the publication had had a struggle for existence. The six volumes published prior to 1895 had cost over eight thousand dollars and this entire sum had been raised by three- and five dollar subscriptions to the volumes, obtained by repeated solicitation by Mrs. Putnam. A very few, like Prof. Sheldon, gave generously. Sometimes the money came so unexpectedly that Mrs. Putnam was wont to say "it sifted down from heaven." When publishing Vol. IV, she writes, "I find people

now understand what publishing proceedings means and are interested at once and willing to help. I have met with great success, without begging in the least. The publication now stands on its own merits."

Mrs. Putnam spent the summer of 1897 in Europe with two of her children, travelling leisurely from Norway to Italy.

On December 11, 1897, Mrs. Putnam writes of celebrating the thirtieth anniversary of the Academy on the 14th, "by a simple reception at Academy afternoon and evening. For days I have cleaned up things. I hope to close this year with every bill settled and all dues collected. The contract for the new [Presbyterian] church was let yesterday. They have offered the old building to me for the Academy for \$5,000,—a great bargain, I think." Four years before, on September 10, 1893, there is mention in a letter of Mrs. Putnam's of the importance of the Academy owning the property on the corner, when the Presbyterian Church removed to other quarters, as they would eventually do.

She never lost sight of this project, and patiently and persistently worked till she persuaded the trustees to see it from her point of view. The Academy owned land on the north for future building purposes, and many thought the old church building would only be an incubus. A few far-sighted trustees realized it was a good investment at least. It has proved a most wise one. There is a hall for lectures and a high basement to contain part of the ever increasing museum. If the Academy had not bought it a large apartment building would have been erected, cutting off light and sunshine from the Museum. It preserves for the Academy one of the most commanding corners in Davenport. The Trustees of the church most generously placed a much lower price on the property than they could have obtained from other parties. On April 3, 1898, Mrs. Putnam writes: "Mr. Cutter says the Jewish Synagogue came to ask the price and wanted to buy the church, but when they heard Mrs. Putnam wanted it for the Academy, they would not make an offer." The Trustees of the Academy bought the church property in 1899.

On December 3, 1899, after the close of the last service held by the Presbyterian church in the building, Dr. Donaldson stepped from the pulpit and handed the key to Mrs. Putnam, then the

oldest living member of the church, who received it on behalf of the Academy. Upon taking the key she said: "No words of mine can adequately express my feelings in accepting the key of this old church, which so many hallowed associations have endeared to me, or of the gratification I feel in knowing my interest in it is not entirely to cease, as this key will pass into the custody of the Davenport Academy of Natural Sciences, an institution which, next my family and my church, holds the dearest place in my heart."

The purchase of the old church entailed an enormous amount of work. The first problem was how to pay for it. Mrs. Putnam was aided in raising the money by the Hon. C. A. Ficke. It was decided to connect the two buildings by a passage way, large enough to be used for museum purposes. Mr. E. S. Hammatt and Mr. A. F. Cutter superintended the construction, while that of cleaning and arranging the two buildings was done by Mrs. Putnam. Griswold College was disbanded at this time, and Bishop Morrison and the trustees of the college generously gave its valuable scientific collection and library to the Academy. With this added space, the Academy could exhibit the collection at once. The work of moving the collection was very great. Mr. C. E. Harrison attended to the transporting and sorting of the books, but for weeks Mrs. Putnam was busy superintending the transfer and arrangement of the collection. All this made the summer a busy one. Mrs. Putnam secured the services of a trained librarian, who began the arrangement and cataloguing of the library, disturbing the dust of years. It was realized as never before what a rare and valuable library the Academy possessed. During all the years that the publication of the Academy proceedings had been going on, laboriously but perseveringly, the library had been steadily growing. Foreign societies had been sending their publications in exchange, thus proving the foresight of those members who inaugurated the printing of original scientific papers by the Academy.

The start made in cataloguing the library has been kept up by Miss Foote-Sheldon, so that now the large collection of books is available for use by scientific students.

On the thirty-third anniversary of the founding of the Academy, December 14, 1900, Science Hall, the new lecture room, was

dedicated. President MacLean and Prof. C. C. Nutting of the State University of Iowa, came from Iowa City, and Prof. Frederick Starr, from the University of Chicago, gave a lecture. Letters from scientific friends all over the country were read, congratulating the Academy on the work achieved during its existence of a third of a century.

As one of the tributes, Prof. Nutting read the following poem:

THE STORY OF TWO WOMEN.

There was a woman on whose heart was pressed the heavy hand of Sorrow.
Her heart was bruised, her head was bowed, her life bereft of hope and light.
This woman was not strong, and so she sat her down and cried:

"Woe has come upon me, and my love lies dead, his work unfinished.
No more is heard his name upon the lips of men. With him is Hope entombed.

Henceforth my life shall be devoid of light, and o'er his grave I'll place
A broken shaft to show the incompleteness of his life cut short of full fruition."

And so it was. Her life was void. His name forgotten in the homes of men.

Again there was a woman on whose heart was pressed the heavy hand of
Sorrow.

Her heart was sore, her head bowed low, her life bereft of light.
But strong this woman was, and brave, and she stood up amid the stress
Of this her dire calamity, and gazed undaunted on the face of Sorrow.

"My love shall live!" she said. "His work unfinished I take up. My life
I give

To see his hope fulfilled. His name shall still be spoken in the courts
Of Wisdom, and a monument I'll raise to show fruition of his cherished
hopes."

And so it was. And wise men came to bring her aid. And lo! Her life
was full

Of light and blessed with fruitful works. No broken shaft raised she
Above his tomb. Instead she reared a monument enduring as is Truth
eternal.

And the wise men bring their tribute of their learning to this shrine.
His name is honored still in Wisdom's court. His work complete. His
hope fulfilled.

And Sorrow, conquered, chastened, owns the sway of Love.

Soon after Mrs. Putnam's return in May, 1901, from California, where she had spent several months for the benefit of her health,

occurred the death of Dr. Barris, an early member, ex-President, and curator of the Academy. He had ever been a faithful friend to Mrs. Putnam, one who encouraged her by his hopeful conversation and charming personality to go on with her work. The death of Dr. Barris left but two out of the group of the early active members: Dr. C. H. Preston, who has been a member of the Publication Committee from its inception and who has ever taken a deep interest in the affairs of the Academy, and Mr. C. E. Harrison, who has given generously of his time and energy to further its success, working with the same loyal interest during the years of discouragement as during those of prosperity. As the office of curator was now vacant, and as the five years' subscription paper expired at this time, some of the most prominent citizens again advocated the closing of the Academy. Instead, Mrs. Putnam arranged to have the present curator of the Academy, Mr. J. H. Paarmann, then a student at the University of Iowa, come to Davenport and remount, classify, and label the fine collection of birds in the museum.

In August of this year Mrs. Putnam, accompanied by her daughter, attended the meeting of the American Association for the Advancement of Science, at Denver. Later, at Glenwood Springs, Colorado, she met with a serious carriage accident which nearly proved fatal, and from the effects of which she never entirely recovered. As she lay helpless, being unable to move for weeks after her return, her mind was full of plans for the "beloved Academy." Among other things she arranged for a course of popular scientific lectures, which was successfully given after Christmas. This was the beginning of the courses which have since become an annual feature of the Academy's work.

In the meantime, how to provide for and find a curator? No sooner was Mrs. Putnam able to move than with painful but unflinching steps she visited the faithful patrons of the Academy and raised the sum of eight hundred dollars for five years, double the amount raised in previous years. In April, 1902, Mr. J. H. Paarmann was appointed Curator, upon which office he entered the following July. He began, in the fall, a series of talks to the school children, illustrated by specimens from the Academy's collections. This was a project in which Mrs. Putnam had always taken deep interest.

After this work was started Mrs. Putnam and her daughter spent several months in California. A letter written to her brother, Mr. J. Duncan, from Del Monte, March 25, 1902, tells of her nervousness in driving (a natural sequence to her terrible accident a few months previously), and of her success in conquering this feeling: "We took the seventeen-mile drive along the Pacific. I never enjoyed a drive more in my life and I think it was because I had entirely mastered myself and my fear of mountain drives. I thought it all over in the night and when the carriage came round, with five seats beside the driver's, and the rest were all ready, I quietly put on my things and astonished them all by taking my seat in the exact position I sat in when the accident occurred last September. One place, where the road ascended a very steep place and turned on top and came down a very abrupt descent, I thought I would get out and wait; but I had started out to conquer, and so I sat still. I must say I drew a long breath when we reached the bottom, but I was master of myself and that is what I long to be above every other thing."

The summer was spent at home, where Mrs. Putnam took up her work for the Academy with her old enthusiasm, taking great interest in the labors of Mr. Paarmann in his new office as Curator. In August she arranged for a successful concert, given by the musicians of Davenport for the benefit of the Academy.

Mrs. Putnam, accompanied by her daughter, attended the meeting of the Americanists in New York in October of this year. She enjoyed meeting old friends and making new ones, listening to scientific papers; but, on looking back, one realizes that while the spirit was as eager to enjoy and impart, the body was growing weaker. The journey was continued to Boston, where she met many old friends, and revived memories of her visits there with her son Duncan. It was her last journey.

Mrs. Putnam was elected a fellow of the American Association for the Advancement of Science, at the December meeting, 1902, in Washington. This unexpected honor greatly pleased her, though she felt herself undeserving it. But, as one of her scientific friends has said, "to whom could it have been more worthily given than to her who had striven so loyally for the advancement of science?"

The Academy was in urgent need of a stereopticon, to use in

the talks Mr. Paarmann gave to the school children; and on January 3, 1903, Mrs. Putnam writes: "Every day I receive money (as the sparks fly out of the fire at me) for the stereopticon. I have written a short report for the annual meeting. We have \$148 in the bank and not a bill to pay, left from last year." On February 14, through gifts of generous friends, she succeeded in paying \$1,000 on a note against the Academy. It was a happy morning for her, as she realized the Academy was now on a better financial basis, besides beginning active educational work.

An exhibition of Indian basketry, planned and managed by Mrs. Putnam, was opened at the Academy on the nineteenth of February. A much larger collection of baskets had been gathered than was expected, and the building was effectively decorated with mats, blankets, and examples of weaving. On the second day of the exhibition, Friday, February 20, 1903, Mrs. Putnam was the life of the company. Some one suggested having a loan exhibition of lace; and her quick mind seized the idea, and with her old-time enthusiasm, in bidding a friend goodbye, she said, "You must come next month to our lace exhibit."

Mrs. Putnam returned home at twilight and, sitting before the open fire, talked of the events of the afternoon, of the meeting with old friends; that it was the most beautiful exhibition ever given in Davenport; what a pleasure the day had been. She went to her room to rest. A Final Rest it was. Painlessly and silently she passed into the World Beyond—a world in which she firmly believed she was to meet her beloved family and the son for whose sake she labored so faithfully in the upbuilding of the Academy.

With kindly thought of friends and with her last hours spent in the institution that had become an integral part of her life, the day was a beautiful closing to a full and unselfish life.

A few days later Science Hall, the old Presbyterian church, which had been so intimately connected with Mrs. Putnam's life, was filled with family friends and citizens, gathered for the simple but impressive funeral exercises. Rev. Dr. John B. Donaldson of the First Presbyterian Church, her pastor, and the Rt. Rev. T. N. Morrison, Bishop of Iowa, an old family friend, conducted the services. Mrs. Putnam was broad-minded in religion as in all the affairs of life, so it seemed fitting that the last services for

her should be conducted by clergymen of different denominations, as had been the case with her husband and eldest son.

Mrs. Putnam was survived by six sons—Charles Morgan, of Minneapolis; Henry St. Clair, a consulting electrical engineer in New York; William Clement, a lawyer in Davenport; George Rockwell, in charge of the United States Coast Survey work in the Philippine Islands; Edward Kirby, in the English Department in Leland Stanford Junior University, California; Benjamin Risley, a mining engineer in Butte, Montana, and by one daughter, Elizabeth Duncan.

Her children having already been provided for, Mrs. Putnam left her entire estate to establish a Putnam Memorial Fund for the benefit of the Davenport Academy of Sciences, subject to an annuity which was waived by her daughter, Elizabeth Duncan Putnam, and to certain other obligations which were assumed by her son, William Clement Putnam. By the terms of her will this fund, amounting in all to about twenty-four thousand dollars, is to be held in trust for the Academy by a board of three trustees and the income is to be used primarily for the publication of scientific papers.

Emphasis has been placed upon Mrs. Putnam's connection with the Academy of Sciences, of which she was President in 1879 and again from 1900 until the time of her death, Treasurer from 1897 to 1900, and Chairman of the Publication Committee from 1881 to 1903. There is a remarkable human interest in Mrs. Putnam's work for the Academy, growing as it did out of her love for her oldest child. To quote the words of a friend: "We all remember vividly the noble and beautiful mother of that large family, who yet found time out of the devotion to her children and her abounding hospitality to magnetize a careless western community and inspire them to rear an institution devoted to pure science. She began the work for the sake of her son. Young as he was, Duncan Putnam had done work of recognized value the world over; and he did the best of it conscious of his sentence of death, but working doggedly with his last strength. To comfort him his mother threw all her splendid vitality and energy into his plans."

But absorbing and exacting as was this interest in the Academy, it by no means measured the breadth of her sympathies and activity. Another friend writes of her: "Because she gave

so much of herself to the Academy did not mean she had less to give to other things; on the other hand, her love for that institution seemed to increase her endowment, to broaden and enrich her spirit, so that other things profited rather than lost thereby. Her great purpose did not cause her to lose her sense of values. Indeed, the charm of her personality was in its many-sidedness. Her love of the beautiful in nature and art, her keen interest in people, and her inspiring belief in them,—all of these things seemed to be stimulated rather than stifled by her great enthusiasm."

In this many-sided life the key-note was always the home. The first duty of every woman, Mrs. Putnam felt, was to her family. From the days when she was a boon companion to her "blue-eyed banditti," as she called her children, entering into all their sports, even to the setting of type, to the days when they had grown to manhood, each varied occupation and experience of theirs received her sympathy and enthusiastic interest.

In her country home Mrs. Putnam delighted to have friends come and share the simple every-day life of the family. It was ever a joy to her to do kind actions. It required no special effort, because it was perfectly natural.

Mrs. Putnam always found time to be interested in the aims and work of others. A chance remark of hers would leave an indelible impression. Many an incident has come to light showing the influence a word or two spoken by her had on the course of a young life.

Sincere indeed was Mrs. Putnam's interest in those causes that touch the human heart. Instances of this have already been mentioned. She was always active in church work and, while seldom talking about religion, lived her christianity in every-day life. She was for several years president of the Home Missionary Society of the Presbytery. She was a charter member of the Ladies' Aid Society to educate young girls, of the Associated Charities of Davenport, and of other similar organizations. She was largely instrumental in bringing a police matron to Davenport. When it was decided to close all the stores in the city at six o'clock in the evening so that the clerks would not be overworked, it was Mrs. Putnam who persuaded the last obdurate owners to sign the agreement. It was this sincere and sympa-

thetic interest in humanity, as well as her personal interest in all whom she knew, even though casually, that made her hosts of friends and endeared her to the people of her home city and to all who came to know her. A friend writes: "No one woman stood for all that she did in the community, the sympathizer with every good work, the originator of many, the presiding genius of the Academy, and, what made this vital and enduring, a rarely beautiful Christian character."

Out of the crowded memories of the past comes a vision of a woman of medium height, clear blue eyes; a well-poised head, crowned with beautiful silver-white hair; an alert, light step; a vivacious manner and quick intellect that may have come from some far away Huguenot ancestor; a voice of unusually sweet and gentle modulation, the whole personality lighted by a smile full of sympathy and enjoyment of life.

Sorrow had written its history on her face, but it was illumined when she talked or listened to others. Although endowed with a rare social instinct and delighting in the contact with her fellows, she was a great lover of nature. Many a sunrise and sunset she watched in Europe, the dawn coming upon the Jungfrau, or the marvellous afterglow at sunset,—a symbol of the resurrection, as she expressed it. Many of her letters from "Woodlawn" are dated "at sunrise." The quiet communing with nature and reading one of the beloved Psalms of David gave her the peace and strength to plan her work for the day, and with a refreshing sleep afterwards she arose bright and sunny as the morning itself. She was one of the most natural of women, perfectly unconscious of self. What people might think of her simply never occurred to her. What they thought of her children or of the Academy was another matter.

Mrs. Putnam's early life, fatherless and with an invalid mother, had developed a naturally forceful character. A happy marriage brought out all the sweeter, unselfish qualities of her nature. She writes, early in her life, "God formed me with a heart so large that even a husband's and children's love does not fill it full to overflowing." She could always enter into the trials and sorrows of others with an unusual sympathy. She was ever a friend to the poor, treating them with a rare equality. The accident of riches was nothing to her,—"A man's a man for a' that." If

people were dull and selfish, though they might have all the world's goods, they were perfectly uninteresting to her. Gossip and unkind remarks were never heard from Mrs. Putnam. She felt that there were so many interesting things in the world to talk about, why waste time in matters worse than trivial. She often quoted the saying "Blessed is the man or woman with a hobby," feeling that the interest in outside affairs broadened the home life and, when sorrows came, enabled a person to rise above them, in work for others. As a friend said, "She was a woman who was not afraid to live up to her convictions." This fearless, unselfish character was what enabled her to go on with the work of the Academy, when a weaker woman would have been discouraged at the difficulties and would have counted the cost and personal sacrifice.

With her earnest purpose and unselfish devotion, Mrs. Putnam was enabled in her well-rounded life of three score and ten years to crystalize her high ideals into permanent results. She was of a most hopeful, cheerful disposition, and while she remembered the past and while it influenced strongly her life, she lived in the present, planning for the future.

Her children arise up and call her blessed.

Give her of the fruit of her hands; and let her own works praise her in the gates.

DAVENPORT, IOWA, December 14, 1905.



W. L. Purnam

WILLIAM CLEMENT PUTNAM

A MEMOIR

BY ELIZABETH DUNCAN PUTNAM

On the western banks of the Mississippi, on the bluffs overlooking the broad river, lies the town of Davenport, in Iowa. The scene is one of quiet beauty, with the river winding onward, peacefully and majestically, amid the encircling hills. Here was born on the twenty-sixth day of June, 1862, William Clement Putnam, the fifth son of Charles Edwin Putnam and Mary Louisa Duncan, his wife.

Brief was his life as the years are told, but into his forty-three years he crowded the work and achievement of a long life. The same traits of foresight, courage, energy and perseverance that had sent his ancestors from their homes in Massachusetts and Virginia to develop new lands, kept him in his native city and enabled him to build up a fortune and leave it for the benefit of Davenport. Descended on his father's side from New England families, men and women who led industrious, simple lives, and on the mother's side from Scotch and Virginians, into whose lives had come much of interesting adventure and history, his own character shows a combination of the traits of both families.

The incidents of Mr. Putnam's life were few. He lived and died in his native city. The first twenty-five years were spent at Woodlawn, a beautiful country place overlooking the Mississippi, about two miles from the center of Davenport. The family life of father, mother, ten sons and one daughter has been graphically portrayed in the letters of his mother, who did much to encourage the children to follow their individual tastes.

Especially strong and decided, even in childhood, were the characteristics of Mr. Putnam. It is interesting, in reading his

early letters, to see indications of the traits of later years. The boy of nine writes to his father, "Now, about the money question," and upon receiving the remittance, thanks him and adds, "I hope I shall not spend it foolishly." His early interest in politics is shown by a letter written a month later to his father, in which he begins, "Hurrah for Grant;" and upon hearing of his father's politics he writes, "I am sorry you like Horace Greeley so much."

Surrounded by his father's large and well selected library and brought up in "a reading family," it was only natural that his latent love for books and knowledge should develop early in life. For many years, by rising early in the morning and retiring late at night, he accomplished an enormous amount of systematic reading of the standard authors. He had a retentive memory, especially for facts and information, and during these years of boyhood amassed a store of knowledge from which he drew at will in later life.

His oldest brother, Duncan, was, at this time, collecting insects and carrying on his scientific work. He took great interest in the occupations of his younger brothers and it is no doubt largely through his influence and through the constant encouragement of his father and mother that Clement Putnam began his collections and interest in outside affairs. An historical society was organized among the brothers at Woodlawn and papers were read at the meetings. Clement Putnam was the dominant and persevering member that carried the society through its existence.

Very early he began to collect material for local history. This interest was developed by a visit to his mother's former home, Jacksonville, Illinois. He met many old friends of his grandfather, Governor Duncan, and gained from them an impetus to his interest in historical subjects. He planned at this time, when only eleven years old, to write a biography of his grandfather. Unfortunately he did not carry out his boyish plan, though he never lost sight of it. He constantly collected material and facts and looked forward to the time when he would have an opportunity to write. When sixteen, he was interviewing old settlers and buying books about the Black Hawk War. His letters show his exact and intimate knowledge of where old books could be bought and of their relative value.

When a copy of Wakefield's "History of the War Between the United States and the Sac and Fox Nations of Indians" was loaned him, he writes on November 26th, 1878: "I was too much interested in the other book [Wakefield's History] to think about it [Cunningham's Lives] at first. I could scarcely believe my eyes when I saw what book it was, for I knew it was Wakefield's book instantly although the title page is gone. I have every other book of importance upon the Black Hawk War except this one and I never expected to have this one in my possession even for a short time, as it is one of the rarest western books ever published, besides being of great value in itself . . . It is to me the most precious relic of a bygone age. . . . Before returning it I would first like to make some extracts from it concerning those things which are of the greatest interest to me, though I am afraid I would never know where to stop, so much am I interested in everything of which it treats." He copied the entire book.

Again on January 13th, 1885, he writes: "I have always had a great passion for old papers and autographs and have already a large and valuable collection. As soon as my collection of grandfather's papers is complete I intend to arrange them and have them bound in volumes."

With his love of collecting came a strong ambition to write. At the age of ten he had written a tragedy of five acts which was acted on an amateur stage at Woodlawn. This was followed by plans for various works in history, but unfortunately his busy life did not enable him to accomplish all he hoped.

Mr. Putnam was educated at the public schools in Davenport and was graduated from the High School in 1880. When but eleven he had decided upon becoming a lawyer. He was ambitious to go first to college, but feeling that his father needed his help, he laid aside this dream and entered the law office of Putnam and Rogers. This prompt and decisive response of the boy to what he felt was a call of duty was characteristic of the man. One wonders what the effect of a university education would have been upon his mind, so eager and enthusiastic for knowledge. He himself always regretted the loss. He spent two years in his father's law office before going to Iowa City to attend the law school of the State University of Iowa, from which he

was graduated in 1883. He was chosen one of the orators of his class, his subject being, "The State." He assisted Chancellor McClain in preparing his "Outlines of Criminal Law and Procedure," published in 1883. He selected cases and "showed a rare judgment for a law student in his first year of study." Soon after his return his father took him into partnership, the firm name being Putnam and Putnam. The next few years were spent in close application to business and devotion to duty.

On the third of June, 1887, the house at Woodlawn was destroyed by fire. All of Mr. Putnam's historical books, manuscripts and valuable collection of old letters relating to western history were burned. It was an irreparable loss. The death of his father, six weeks later, left the family in peculiarly sad and desolate circumstances and added new responsibilities to his life. He assumed the care of managing the affairs of his mother and brothers and sister, becoming the virtual head of the family. Nobly did he perform this duty. He arranged the finances so that his younger brothers received a college or technical education, and sold the old homestead to such advantage that his mother was placed in comfortable circumstances. In the autumn of this year the family moved into town. Mr. Putnam soon after bought the house in which they first lived and took great interest in improving the property and making it a family home. Into this house he gathered his constantly growing collection of books and works of art. He was an intense lover of home and enjoyed having his family with him, but unselfishly urged his mother and sister's taking an extensive European trip in 1889, and numerous other journeys.

Charles E. Putnam had numerous business interests besides his law practice. Clement Putnam succeeded his father as president in many of these organizations. Often the young man of twenty-five, who looked much younger than his years, presided at a meeting of gray-haired men, contemporaries of his father.

Charles E. Putnam had been agent for the property in Davenport belonging to Charles Velie of Evansville, Indiana. This consisted of a half block of buildings forming the old LeClaire, later the Newcomb, Block, in the center of the business district of Davenport. Clement Putnam assumed the management of it during his father's lifetime and later Mr. Velie, one of many of the loyal clients of his father, continued him in charge of his in-

terests. Thus he became familiar with it and when the opportunity offered, in 1895, to purchase the property, he realized its value and bought it. It is this property, with its large rental, that becomes the chief source of the income of his bequest to the Davenport Academy of Sciences. The improvement and care of these buildings gradually absorbed most of his time. From a financial standpoint it was most advantageous. Mr. Putnam had marked business ability, as is shown by his acquisition, in his short life, of a large fortune. His business interests, however, prevented him from becoming the distinguished lawyer that the few briefs and opinions he wrote indicate he might have been with the ability he possessed. He had a clear mind and forceful power of expression, and enjoyed the discussion of legal questions. Chancellor McClain, now Judge of the Supreme Court of Iowa, writes of him: "I regarded Mr. Putnam as having a mature and sound legal mind and urged him to undertake some legal writing, but he seemed too busy for it although it was in accordance with his tastes."

Business affairs necessitated frequent visits to New York and gave him, incidentally, an opportunity to come into closer touch with the literary and artistic world. Unconsciously these visits broadened his outlook on life. He was now able to buy the rare and beautiful books he had always loved. Even when his income was small, the few books he bought were chosen with care and he was beginning to plan and develop in his mind the scope of his future library. He took infinite pains in the selection of any book or picture, and his perseverance was remarkable. For years he was on the lookout for Wakefield's "History of the War," and at last, in 1902, he was rewarded and became the possessor of the little old yellow book that had aroused his enthusiasm as a boy.

He became interested in fine publications and illustrations and gradually collected a rare library on architecture, music and painting, besides general literature and history. Librarians have expressed interest in his library on account of its extent and range. Though guarding his books with zealous care, he was ever willing to loan them to any one studying a special subject, aiding them also by his own extensive knowledge.

After buying a few etchings in 1898 in New York, he became

interested in the subject and in time came to own a valuable collection of works by the best known etchers, besides almost every book on etching. He mastered the literature and technical criticism of the subject in the same thorough manner as he mastered everything he undertook.

Mr. Putnam commenced early in life to buy paintings, chiefly small good examples of modern artists. He writes on June 9th, 1891, "I want to add to my collection of paintings every year, laying the foundations for the Art Gallery I intend to have in my Castle in Spain when I build it." His art gallery was a dream unfulfilled for himself, but by the provisions of his will it will become a reality for the town he loved.

Mr. Putnam always looked forward to a time of leisure in which he could do the writing he planned. His extensive knowledge of western history, with his accurate mode of thought and expression, makes it a matter of deep regret that the only historical writing preserved is a short paper on "Davenport and Vicinity in the War of 1812," written in 1877, and read before the historical section of the Davenport Academy of Sciences. He wrote a memoir of his father, Charles E. Putnam, in 1898, published in Proceedings of the Academy, and three papers for the Contemporary Club, composed of the leading business and professional men of Davenport. The titles of the papers show the trend of his thought toward some of the questions of the day:

1898. "Some Problems of Modern Democracy."

1902. "Civic Beauty."

1905. "International Arbitration and the Peace Movement."

He possessed a clear, forceful style and a good command of the English language.

As the years went on, his interest in public affairs steadily increased. No question came up affecting the public welfare of Davenport but he took a deep interest in it and went to considerable personal sacrifice to achieve the end in view if it was for the betterment of the city. Never did his faith waver in the future of Davenport. He had high ideals and believed in planning and building for the future. The great fault, he felt, of the average citizen, was in letting franchises or laws pass unnoticed if they did not happen to affect his personal interest or pocket-book. It was only a very few who ever troubled themselves to

protest or be on the lookout for the best interests of the city. He himself took a deep interest in municipal affairs, especially in the city's parks and public institutions. Referring to the park system of Boston, Mr. Putnam writes: "Every one of us should lay the lesson of that noble work to our hearts and do what we can to make the city of our home the better and the more beautiful for our having lived in it."

There are copies of frequent letters written by Mr. Putnam to our United States senator about public affairs, especially protesting against the tariff on works of art. He felt that America needed all the art and beauty that could be imported to counteract our commercial spirit. When urged to help in the endowment of an eastern institution, he replied that whatever he did for art would be done in his native town. Here he hoped there might be a gallery, small but with a few choice paintings. In 1898 he was interested in selecting pictures and bas reliefs to decorate the two upper rooms in the grammar school attended by many members of the family. In 1905 he gave a full-sized frieze of Donatello's "Children" to the Public Library for the children's room. He also loaned them his carefully selected collection of a hundred large Braun photographs of the most famous paintings by artists of all countries and ages, framed and labeled.

Mr. Putnam was seldom away from Davenport. A boyhood journey to the Centennial, various business trips and one European tour complete the record of his journeys. His life is an example of steady application to business and shows how, with few opportunities of travel, can come the love of the best in art, music and literature. His only trip abroad was in 1903 when for seven months he travelled, with his sister, through the principal cities and countries of Europe. In looking back one realizes the reason of his intense enthusiasm and desire to see places of interest. For years he had worked perseveringly and read extensively and now when his holiday came he enjoyed it with the zest of a boy. Europe was never visited by a more appreciative or intelligent visitor. His familiarity with history, his love of architecture, painting and sculpture, his interest in people, customs, and the different institutions of the countries made the trip a memorable one. He considered this the beginning of many journeys. It was his only one.

From his early interest in the Historical section, Mr. Putnam became more interested in the Davenport Academy of Sciences. The untiring work for this institution of his brother Duncan, devotedly supported by his father and mother, all tended to influence a man of such loyal character as his to take up the work as one by one they laid it down. There was a deep and peculiar attachment between Clement Putnam and his mother, and it was for her sake especially he did so much for the Davenport Academy of Sciences. Even as a student at the law school he writes, urging that the affairs of the Academy be established on "a sound financial basis." After the death of his father he succeeded to his position of looking after the finances of the Academy, a position to which there were no rival claimants. When the treasury was empty Mr. Putnam, like his father, advanced the money to pay the bills, ever anxious that the credit of the Academy should stand unimpaired.

During the years from 1876 to 1880 he took a keen interest in the Historical Section of the Academy. He felt that the study of local history and the collection in its archives of local historical material should be an important feature of the Academy work. In his report as secretary of the Historical Section, on January 7th, 1880, he speaks of the gift of the papers of Antoine LeClaire, "many of them of the greatest value and importance in illustrating the early history of this region, and quite a number of old French papers of great interest. It is out of such material as this that the historian weaves his interesting narrative, and the value of these old manuscript collections cannot be too deeply appreciated. There have been deposited, in the library of the Section, files of New York papers published during the late war, and twenty-two volumes of the Davenport *Gazette* from its commencement. Next in order to collections of manuscripts, newspaper files are of great utility as historical material. But by far the most important work of this past year was the series of meetings of the old settlers of this county, held during the spring and summer at the Academy. As a result of these meetings and of circulars sent among the pioneer settlers still living, a large number of letters giving interesting narratives of early days have been sent to the president of the Section; others have been promised, and when the whole series has been completed it will form a store-

house filled with information which must otherwise have been lost."

Mr. Putnam was Trustee of the Academy from 1887 to his death, and was on the finance committee for fifteen years. His last act was to dictate the report of the finance committee for the annual meeting, announcing that after strenuous efforts the Academy was free from debt, and adding, "this is probably the first time since the founding of the Academy, nearly forty years ago, that this could be said, so we feel that the Academy is to be congratulated on its splendid financial condition; but people must remember that this is only a means of accomplishing still greater ends in the future, in developing the internal work of the Academy, in providing new cases and apparatus and assisting in the important work of the Academy in the schools." This report was dictated with difficulty and pain. Loyal was he even on his deathbed to the trust he felt his mother had left to him. His bequest to the Davenport Academy of Sciences crowns his mother's life work for this institution.

In the midst of enjoyment and activity in the present and plans for the future came his first and last illness. His strong will had kept him at work too long. There were only a few days of illness, serious from the first, with a rally to dictate his reports and give directions to donate a large collection of old and rare Arizona baskets to the Academy. His death came on the morning of January thirteenth, 1906.

Mr. Putnam was a man of strong personality. He combined the thoroughness and faculty of taking infinite pains with the greatest persistence and pleasure in overcoming all obstacles. Once started upon a subject, his determination never let him rest until he had mastered it thoroughly. In many traits he reminded one strongly of his mother. He had a great desire to acquire information from other people, and possessed the power of assimilation, so that anything once acquired was always useful. He had keen judgment and appreciation of literature, art and music. One might differ from him, but he was ever interesting. He was fearless in speech. He was generous and ready to aid in all good causes and help with counsel and personal interest in the affairs of any worthy person. He combined a great amount of sentiment, which he tried to conceal, with the clear-headed views of a

business man and lawyer. Those who knew him in his own home, surrounded by his books and pictures and talking with congenial friends, felt to the full the charm and power of Mr. Putnam.

His life, though unfinished, was more complete than many a longer one. Wisely and clearly he laid his plans for the future. Devoted to his family, home and city, he left his fortune, subject to annuities to his brothers and sister, and his collection of art, historical and scientific books, besides his paintings and sculpture, to trustees as an endowment for the Davenport Academy of Sciences, for the benefit of "the citizens of this community wherein my father and mother so long lived and labored for the public weal."

WILL OF MARY LOUISA DUNCAN PUTNAM

By the will of Mary Louisa Duncan Putnam her estate, subject to an annuity which was waived by her daughter, Elizabeth Duncan Putnam, and to certain other obligations which were assumed by her son, William Clement Putnam, is left to three trustees for the benefit of the Davenport Academy of Sciences. The trust, designated as the "Putnam Memorial Fund," is founded as a memorial to her husband, Charles Edwin Putnam, and her son Joseph Duncan Putnam.

By the terms of the trust William Clement Putnam is named as legal trustee during his life, his successors to be chosen by her surviving children, approved by the court, and, after the death of all the children, directly by the judge of the court. With him are to be associated two other trustees: one, her daughter, Elizabeth Duncan Putnam, and after her decease, one person to be chosen by the members of the Publication Committee of the Davenport Academy of Sciences, and the other, a person to be chosen by the Board of Trustees of the Academy, both of the last trustees, when so chosen, to be for a period of three years. The trustees of the trust fund are to make an annual report to the trustees of the Academy. The trustees shall use the net income from this trust fund as follows: Not to exceed ten (10) per cent in any one year may be used for the "care and preservation of, and additions to, the collection of entomological specimens and books made by my said son, Joseph Duncan Putnam, and now in the building of the said Academy." The balance of the income shall be used "for the publication and distribution of the papers and transactions of said Academy, which shall be of scientific, or ethnological, and (on special occasions if deemed desirable) of historical value and interest, and assist in the diffusion of knowledge, it being my desire generally that at least one paper in each volume published be upon some entomological subject." It is further provided that the trustees may use a portion of the income of the fund, not to exceed one-fourth in any one year,

“toward the payment of the salary of a curator of said Academy, if such use of a portion of said income in their opinion becomes necessary to properly maintain the work of said Academy. But I earnestly hope that the said Academy may in the near future receive a sufficiently large endowment from public-spirited citizens, or others, to enable it to properly carry on its great work aside from its publications, leaving the income from this trust fund to be used solely for the purpose for which the trust has been founded.”

WILL OF WILLIAM CLEMENT PUTNAM

In his will William Clement Putnam left his entire estate in trust for the benefit of the Davenport Academy of Sciences, naming as trustees of the fund thus created his brothers, Henry St. Clair Putnam, George Rockwell Putnam, Edward Kirby Putnam, Benjamin Risley Putnam, and his sister, Elizabeth Duncan Putnam. He provides first for the settlement of his estate and the preservation of his business and other property.

The homestead, with the personal property contained therein, is given to his sister during her life. After her decease the homestead is to revert to the estate, to be merged in the trust fund and the personal property is to be divided among relatives, "excepting however that when such distribution of my personal effects is made, either upon written notice from my said sister to my said Executors and Trustees, or the survivors of them, during her lifetime, or in any event upon her decease, I give and bequeath all my art, historical and scientific books, together with all my oil and water color paintings, etchings, engravings, drawings, sculpture and other works of art, to the Davenport Academy of Sciences of Davenport, Iowa, to be kept in a fire-proof art gallery in one of its buildings to be built as hereinafter provided, and I further direct that, after the completion of such fire-proof art gallery, my collection of English water colors shall be placed therein, as soon as possible, to prevent the risk of their destruction by fire, even before title thereto may pass pursuant to the above provisions. The gift of the foregoing books and works of art to the said Davenport Academy of Sciences is made upon the express condition that none of said books, pictures and other works of art, shall ever be sold or disposed of by said Academy or its successors."

Annuities are designated to be paid to his four brothers and sister in lieu of their compensation as executors and trustees, and provision is made for the rebuilding, with modern and fire-proof construction, of the buildings upon his business property. The fifth paragraph of the will then provides for the Academy as follows: "The balance remaining each year from the net income of all my

estate as aforesaid, I direct my said Executors and Trustees, or the survivors of them, to pay to the Trustees of the Putnam Memorial Fund of the Davenport Academy of Sciences, of the City of Davenport, Iowa, said Trustee and Board of Trustees being the ones designated in the Last Will and Testament of my mother, Mary L. D. Putnam, now deceased, such payments of income to be made as often as my said Executors and Trustees, or their survivors, may think best, but at least annually, and all of said balance of the net income arising from my estate to be used for the benefit of the said Davenport Academy of Sciences, or its successors, or otherwise, upon the terms and under the conditions in the Seventh paragraph of this Will particularly set forth."

The seventh paragraph of the will provides for the permanent maintenance of the trust fund and its use for the benefit of the Academy of Sciences:

"Seventh. Subject to the foregoing provisions of this Will, and as a memorial to my beloved parents, Charles Edwin Putnam, and Mary Louisa Duncan Putnam, deceased, I give, devise, and bequeath all of my estate, real, personal, and mixed, and wherever situated, upon the decease of the last survivor of my brothers and sister hereinbefore named, to the Trustee, and Board of Trustees, of the Putnam Memorial Fund, and to his and their successor or successors in trust forever, as the same are designated in the duly probated last will and testament of my mother, Mary L. D. Putnam, deceased, and as the same may be from time to time hereafter appointed, elected, and qualified, as is in my mother's said will provided, said property and estate to be held in the same manner in all respects as is in my mother's said will directed, for the benefit of the Davenport Academy of Sciences, of Davenport, Iowa, or its successors, and the income therefrom arising, together with the residuary income from my estate prior to the decease of all my brothers and sister hereinbefore named as provided in the Fifth paragraph of this Will, to be used for the following purposes only, to-wit: *First.* In the payment of all taxes, insurance, repairs, improvements, and all other expenses and charges of whatever nature or description which may be from time to time required in the proper management and care of said trust estate, and in the proper maintenance in first-class

condition of all property and assets belonging to said trust estate.

Second. In the rebuilding of any of the buildings upon any of the real estate belonging to said trust fund whenever such rebuilding may become necessary in order to properly maintain or increase the value of such real estate. *Third.* In the erection

of new buildings for, or additions to the present buildings of, the said Davenport Academy of Sciences, it being my earnest desire, however, that such building fund be allowed to accumulate until it reaches at least Fifty Thousand (\$50,000.00) Dollars, and is in any event large enough to permit the erection of a thoroughly satisfactory, handsome, and fire-proof structure, which will be in the highest degree creditable and useful to the said Academy, and to the City and State in which it is located, and which shall contain, in addition to fire-proof museum rooms, a fire-proof art gallery for the proper exhibition and preservation of works of art which shall be of genuine value and merit only. *Fourth.*

After providing as large as possible a sinking fund each year for the erection of said building or buildings of the said Davenport Academy of Sciences, or after providing for the payment of any additional obligations incurred in the erection of such buildings, the remainder of said net income may be used each year, so far as necessary, for the general support and maintenance of the said Davenport Academy of Sciences, or its successor; and after the erection of such building or buildings the whole of said income may be used if desired towards the care and maintenance of said building, museum, art gallery, and library, the support of the curator and other employees, the prosecution of the work of the Academy, the purchase of additions to its museum, library, and art gallery, and the publication of its proceedings, and of papers of scientific, or historical, value and interest, until it shall again become necessary to erect another new building for the said Davenport Academy of Sciences, when such portion as may be deemed advisable the net income from said trust estate shall again be used towards the establishment of another building sinking fund. In the event that the said Davenport Academy of Sciences shall ever cease to exist, and shall have no successors in the City of Davenport, then and in that event I direct that the Trustees of the said Putnam Memorial Fund, to

be chosen in such case by the court having probate jurisdiction in the City of Davenport, Iowa, as provided in the last will of Mary L. D. Putnam, deceased, shall proceed to execute and carry out the purposes and intents of the trusts in this will provided, as hereinbefore expressed, as nearly as may be, and, if necessary, to found some other institution in the said City of Davenport which shall as effectually and usefully as possible accomplish such purposes and intents, or similar ones which shall be of beneficent use to the citizens of this community wherein my father and mother so long lived and labored for the public weal."

List of Fishes Collected at Hong Kong by Captain William Finch, with Description of Five New Species

BY DAVID STARR JORDAN AND ALVIN SEALE

IN the summer of 1900, in connection with the explorations of Japan made by Professors David Starr Jordan and John Otterbein Snyder, a collection of fishes from the market of Hong Kong was obtained by Captain William Finch, commander of the steamer Gaelic of the Pacific Mail Steamship Company. This collection was sent to the museum of Stanford University, a series of duplicates being placed in the United States National Museum. As the fauna of no part of the world is less exactly known than that of China, it is worth while to place this list on record. The following species seem to be new:

<i>Sphyræna putnamiæ</i>	No. 9063 Stanford University.
<i>Caranx altissimus</i>	No. 9066
<i>Amia elizabethæ</i>	No. 9064
<i>Pseudoscæna undovittata</i>	No. 9065
<i>Insidiator detrusus</i>	No. 9067

Family CARCHARIIDÆ.

1. *Scoliodon acutus* (Rüppell).

One specimen, length 18 inches, snout about equal to distance from eye to gill opening, pectorals with posterior margin slightly concave, length of base of anal one-half its distance from ventral, teeth entire.

Color grayish, top of caudal dusky.

Family SPHYRNIDÆ.

2. *Sphyrna zygzæna* (Linnæus).

One specimen of the common Hammer Head shark. Length 18 inches.

Family NARCOBATIDÆ.

3. *Narcine timlei* (Bloch and Schneider). (Plate 1).

Disk almost round, the two dorsals about equal, hind margin of caudal rounded, united with lower; no fringes on spiracles, which are immediately behind eye.

Color, in spirits, light brown; the upper surface with large, round, brown spots larger than interspaces; ventral surface white.

Two specimens. Length 7-7.20 inches.

Family DASYATIDÆ.

4. *Dasyatis zugei* (Müller and Henle).

Snout rather long-acuminate, pointed at tip, the margins nearly straight. Width of disk slightly greater than its length; length of disk 1.75 in the long whip-like tail; a prominent fold or membrane on upper and lower side of tail; upper surface of the disk smooth (young); eye two in interorbital space; length of eye about equal to the spiracle immediately behind it.

Color, in spirits, uniform light brown above; white below; membrane on tail black.

Two specimens. Length 11-11.50 inches; from Hong Kong.

In overhauling our Japanese material we find nothing which really corresponds to *Dasyatis kuhli*, and the latter species, known by the bluish spots, should be stricken from the list of fishes of Japan. We are not sure that the specimens called *Dasyatis kuhli* from Japan are distinct from *Dasyatis akajei*.

Family DOROSOMATIDÆ.

5. *Konosirus thrissa* (Linnæus).

(*Clupea nasus* Bloch).

Head 4 in length; depth 2.75; eye 3.85; D. 16, the last ray elongate; A. 22, the snout projecting beyond the lower jaw, maxillary extending to below middle of eye; the last dorsal ray elongate, reaching base of caudal.

Color, in spirits, brownish above each row of scales with a line of brown spots, uniform silvery below; a large dusky blotch posterior to upper margin of opercle.

This species is quite distinct from the Japanese species, *Kono-*

sirus punctatus, which species is more elongate, with the upper jaw less prominent.

Three specimens. Length 6–6.25 inches.

There is yet no trustworthy evidence that *Konosirus thrissa* occurs in Japan, or that *Konosirus punctatus* is found in China. *Chalassus aquosus* Richardson, from Canton, seems to be *K. thrissa*.

Family CLUPEIDÆ.

6. *Ilisha elongata* (Bennett).

Head 4.20 in length; depth 7.50; eye 3.10; adipose eyelid well developed; origin of dorsal midway between tip of snout and base of caudal, anal long, abdomen sharp.

Color, in spirits, silvery white; no dusky markings.

One specimen. Length 16 inches.

Family SYNODONTIDÆ.

7. *Saurida japonica* (Houttuyn).

Saurida argyrophanes (Richardson).

Saurida elongata (Schlegel).

Head 4.50 in length; depth 7.50; eye 6 in head; D. 11; A. 10; scales about 56; snout 4.50 in head; interorbital about equal to snout; adipose eyelid little developed; eye situated on line with middle of lower jaw, a ridge on sides of tail.

Color, in spirits, brownish above with some indistinct blotches, white below; pectorals grayish; caudal grayish-white.

Three specimens. Length 6–6.50 inches.

Family CYPRINIDÆ.

8. *Cyprinus carpio* Linnæus.

Head 3 in length; depth 3; eye 5.50 in head; D. III, 22; A. III, 5, barbels 2; largest dorsal and anal spine serrated behind; scales 30.

Color, in spirits, dusky above; yellowish on lower sides and belly.

Four specimens. Length 7–8 inches.

9. *Ctenopharyngodon idella* (Cuv. and Val.)

Head 3.80 in length; depth 4.75; scales 42, D. 11; A. 10; eye 7; snout 2.85, lips thick, 15 rows of scales before the dorsal, insertion of ventrals on line with origin of dorsal.

Color, in spirits, silvery with slight dusky wash at margin of scales, a bluish wash above.

One specimen. Length 14.50 inches.

Family MONOPTERIDÆ.

10. *Monopterus albus* (Zuieww).

Head 14.75 in total length.

Color, a drab above, slightly lighter below, with slight indistinct line-marking on under surface.

Three specimens. Length 11-12.50.

Family MURÆNESOCIDÆ.

11. *Murænesox talabon* (Cuvier).

Head 3 in trunk; snout 3.50 in head; mouth, from angle, 1.10 in head; vomerine teeth are conical, straight, wide set, none of them with lobes.

Color, in spirits, grayish, washed with yellowish below, darker above; dorsal with dusky margin.

One specimen. Length 42 inches.

Family MUGILIDÆ.

12. *Mugil cephalus* Linnæus.

(*Mugil aur* Forskål).

Head 3.75; depth 4.15; eye 4.25 in head; D. IV, 8; A. III, 8; scales 39.

Color, in spirits, a light wash of brownish above; silvery below, indistinct dark spot at axil; tip of caudal with a white wash of dusky; fins all white.

Three specimens. Length 5.55-6.50 inches.

This species is identical with the Japanese species. *Mugil aur* (= *cephalotus* = *japonicus*), but as yet no characters separating it from the cosmopolitan *Mugil cephalus* have been pointed out.

Family SPHYRÆNIDÆ.

13. *Sphyræna putnamiæ* Jordan and Seale, new species.

Head (including under jaw) 1.98 in length to base of caudal; depth 7; eye 6.50 in head; D. V, 10; A. 9; scales about 152;

opercle rounded, without a distinct point; preopercle rounded; snout 2 in head; interorbital 3 in snout; opercles and cheeks scaled.

Body elongate, slightly compressed; the head strongly pointed; depth of caudal peduncle 2 in snout; lateral line distinct, 23 series of scales between lateral line and base of dorsal at origin, lower jaw prolonged; mouth large; maxillary reaching to below anterior third of eye; its length 2 in head; teeth in lower jaw in single row, about 10 on each side, directed backward, a single large chisel-like tooth at symphysis; teeth of upper jaw much larger with an outer row of small teeth; six very large teeth on each side in the inner row; origin of dorsal over anterior third of the ventrals; longest dorsal spine 1.50 in snout; origin of soft dorsal equal to distance between base of caudal and origin of first dorsal; origin of anal under anterior third of soft dorsal; base of anal and base of soft dorsal equal 1.70 in snout; caudal emarginate; pectorals short, 1.75 in snout; scales deciduous.

Color, in spirits, yellowish white, grayish on back, a dusky wash on upper part of head; the dorsal fins and tip of caudal with a slight wash of dusky.

Three specimens from Hong Kong, China. Length 7.50-8 inches.

The type is No. 9063 Stanford University, from Hong Kong. Length 7.90 inches.

This species bears some resemblance to the Japanese *Sphyræna japonica* Cuv. and Val., but the scales are much smaller even than in the latter. *Sphyræna chinensis* Lacépède, based on a Chinese drawing, is wholly unrecognizable. The species is named for Mrs. Putnam, the honored patron of the Davenport Academy of Sciences.

Family HOLOCENTRIDÆ.

14. *Holocentrus ruber* (Forskål). (Plate 2).

Head 3 in length; depth 3; eye 2.75; D. XI, 13; A. IV, 9; scales 2-38.

Color, in spirits, yellowish white with several pale red lines on outer edge of caudal; and membrane between last anal spine and first ray dusky, a red blotch just below base of dorsal.

Two specimens. Length 6-7 inches.

These differ from *Holocentrus praslin* Lacépède, a species or subspecies, which replaces *H. ruber*, in the Riukiu Islands and in the South Seas generally, in the much paler coloration, there being no purple-black stripes or markings.

Family TRICHIURIDÆ.

15. *Trichiurus japonicus* Schlegel.

Head 6.25 in length; depth 12.75; D. 1.40; eye 2.50 in snout. Color, in spirits, silvery; dorsal yellowish with dusky outer margin.

Family SCOMBRIDÆ.

16. *Scomberomorus guttatus* (Bloch and Schneider).

Head 4 in length; depth 5; eye 6 in head; D., XVI, -I, 16 IX; A. 1, 20, X; about 12 triangular teeth in each side of upper jaw; maxillary extends to posterior margin of eye.

Color, in spirits, bluish above, silvery below sides; numerous round dusky spots; lobes of dorsal, anal, caudal yellowish.

Three specimens. Length 11 to 12 inches.

Family CARANGIDÆ.

17. *Decapterus russelli* (Rüppell).
(*Caranx maruadsi* Schlegel).

Head 3.50 in length; depth 4; eye 3.10 in head, the adipose eyelid well developed. D. VIII, -I, 29-I; A. II, -I, 27.

Color, in spirits, silvery, slightly brownish above; a distinct opercular spot.

Four specimens. Length about 5 inches.

18. *Caranx kalla* Cuv. and Val.

Head 3.75; depth 2.75 in length to base of caudal; eye 2.50 in head; the posterior adipose eyelid well developed. D. VI, 23; A. II, -I, 20; curved portion of lateral line 1.75 into straight part, the line becoming straight under fourth dorsal ray; 43 armed plates in straight portion; teeth in jaws, vomer, palatines and tongue; no canines; breast scaled.

Color, in spirits, brownish above, silvery with yellowish reflection below, opercular spot distinct; posterior margin of opercles dusky.

One specimen. Length 5 inches.

19. *Caranx altissimus* Jordan and Seale, new species. (Plate 3).

Head 3; depth 1.75 in length to base of caudal; eye 3 in head; no adipose eyelid; snout 2.90 in head; D. VIII, 24; A. II-I, 21; small teeth on jaws, vomer, palatines and tongue, the teeth of jaws in two or more series; no canines; interorbital about one-third less than snout. Body elevated, compressed, the profile evenly rounded, the body very deep; breast naked; the lateral line curved to below posterior third of soft dorsal, the straight portion 1.65 in curve. There are about 35 armed scales in straight portion of lateral line; the scutes not strongly developed; maxillary reaching to below the anterior margin of eye; opercles with notch on upper part; caudal peduncle slim, its length twice its depth; dorsal spines connected, the third spine the longest, 2.75 in head; lobe of soft dorsal 2 in head; anal similar to soft dorsal, its lobe 1.75 in head; ventrals not reaching base of anal, their length 1.75 in head; pectorals 1.10 in head; caudal deeply forked.

Color, in spirits, lower half silvery; upper half with grayish wash; usually four indistinct wide vertical bands of gray on sides; caudal yellowish without dusky margin; ventrals white with a slight wash of dusky at tip, other fins whitish, unmarked; opercular spot very indistinct; a dusky blotch at inner axis of pectorals; a dusky blotch on upper part of eye.

Two specimens from Hong Kong, China. Length 4.75-5 inches.

The type is No. 9066 Stanford University. Length 4.75 inches.

In form this fish somewhat resembles the Japanese *Caranx equula* (Schlegel) but it is deeper and more gibbous on upper profile. The fins in *Caranx equula* have no dark markings.

20. *Caranx atropus* (Bloch and Schneider).

(*Caranx nigripes* Cuv. & Val.)

Head 3.75 in head; depth $\frac{3}{2}$ 1.75; curved portion of lateral line 1.75 in straight part; D. VI-II, 22; A. II, -I, 18; teeth in villiform bands on jaws, vomer, palatines and tongue; breast naked; about 44 armed scales in straight portion of lateral line.

Color, in spirits, brownish above, silvery below; ventrals black, other fins yellowish white.

One specimen from Hong Kong. Length 5 inches.

This species is characterized by the long black ventrals.

Family STROMATEIDÆ.

21. *Stromateoides argenteus* (Bloch).

Head 4.10 in length; depth 1.40; eye 3.75 in head; ventrals none; gill membranes at isthmus united up to a line with lower base of pectorals, lateral line smooth.

Color, in spirits, silvery white, bluish above, yellowish on caudal and caudal peduncle, lobe of dorsal dusky; pectorals yellowish.

One specimen. Length 11 inches.

22. *Apolectus niger* (Bloch).

Head 3.30 in length; depth 1.90; eye 4.75 in head; spinous dorsal obsolete; soft dorsal about 38, A. about 38, no ventrals; pectorals long and falcate, their length greater than head, being 2.18 in length of body, lateral line complete, but slightly curved, and with a few (17-18) slightly developed plates along sides of caudal peduncle; apparently a single row of very small teeth in each jaw, more on vomer or palatine; small scales entirely covering body; lobes of caudal equal.

Color, in spirits, grayish with some slight tints of bluish, some yellowish blotches on head and on lateral rays of caudal; a large, very distinct and sharply defined opercular spot in front of pectoral fin.

One large specimen.

Family EQUULIDÆ.

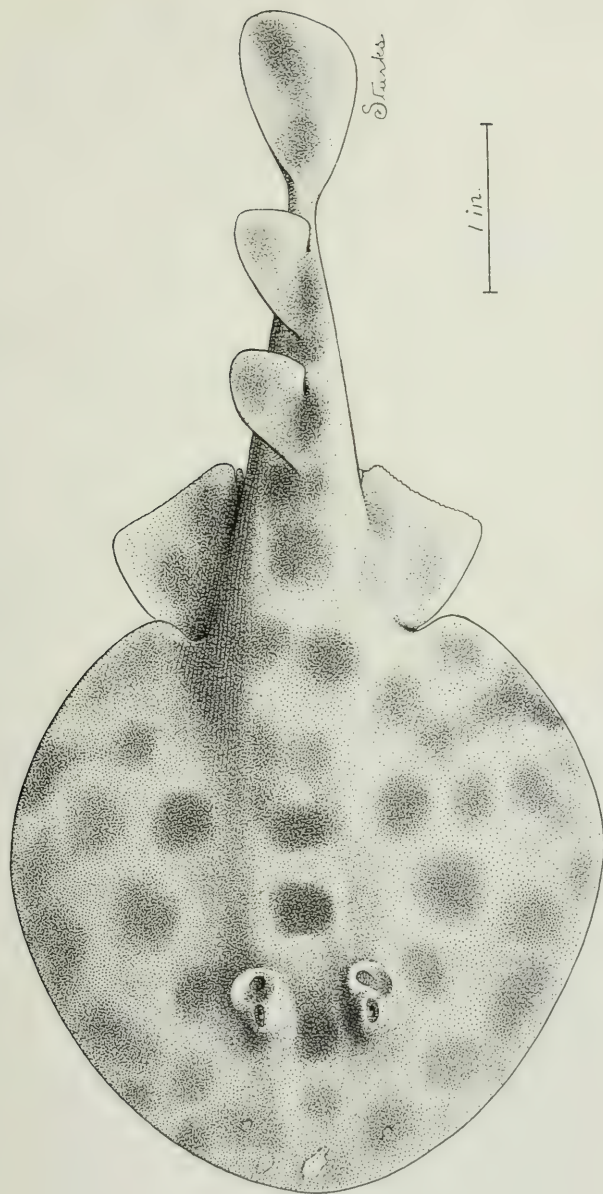
23. *Equula insidiator* (Bloch).

Head 4 in length; depth 2.35; eye 2.50 in head; lateral line incomplete; D. VIII, 16; A. III, 14; breast naked; supraorbital finely serrated, mouth almost vertical.

Color silvery, a black line from lower anterior margin of orbit to chin; back with irregular vertical blackish streaks usually interrupted with spots.

Four specimens. Length about 3.20 inches.

These are similar in most respects to specimens from Manila, although the latter have a little larger eye and a smaller number of bands on the back.



NARCINA TIMLEI (BLOCH AND SCHNEIDER).

Jordan and Seale—Fishes From Hong Kong.

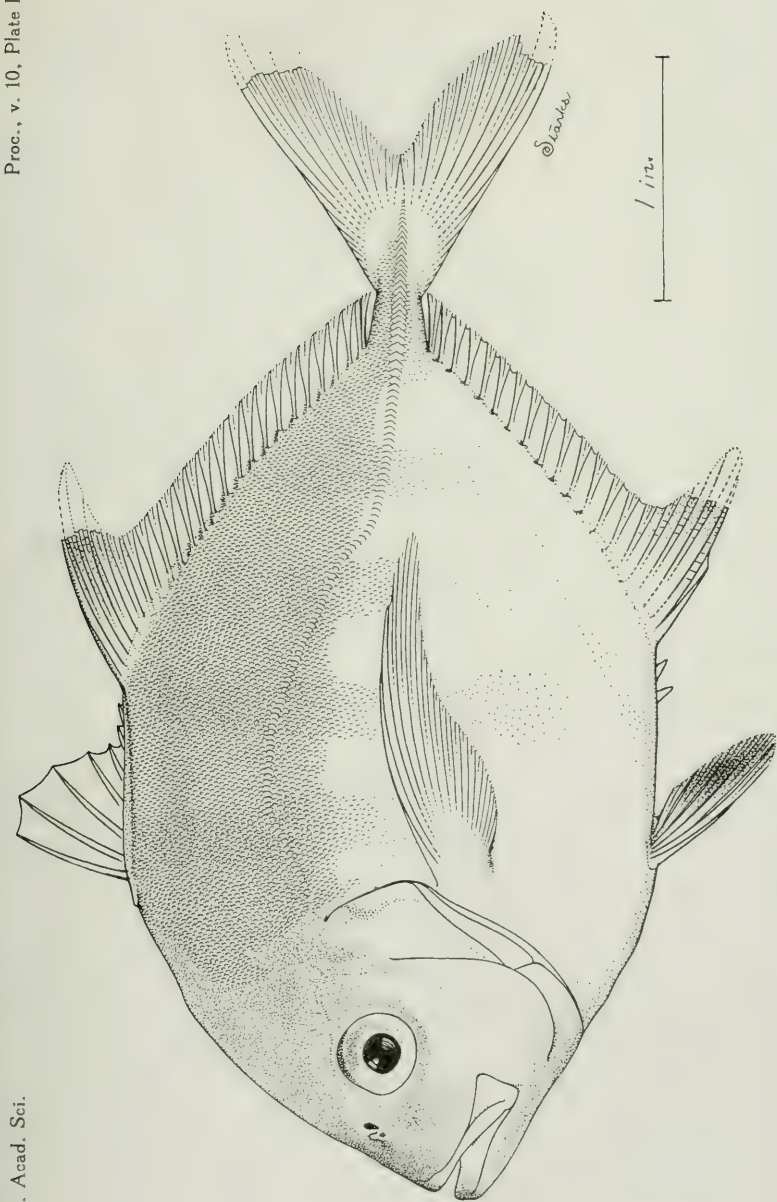
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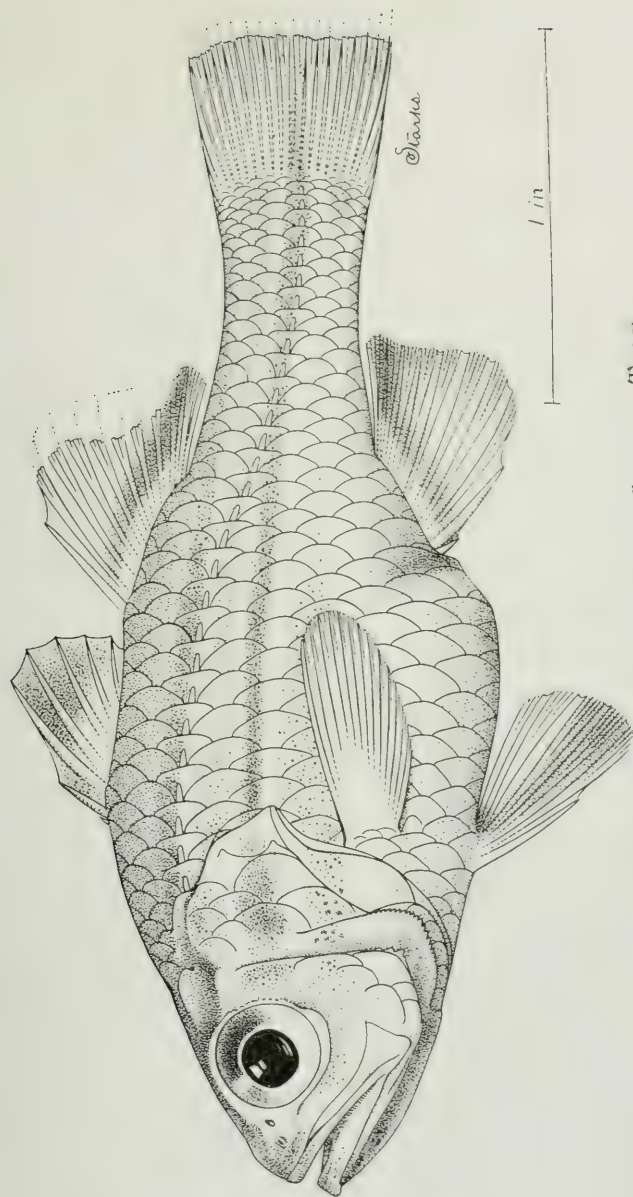


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Jordan and Seale—Fishes From Hong Kong
Atkinson Del.

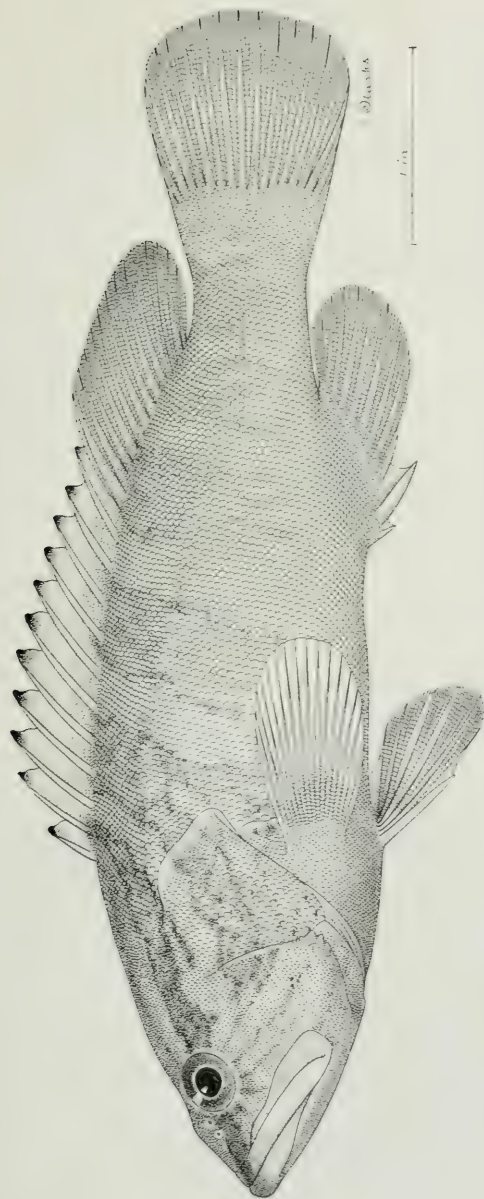
HOLOCENTRUS RUBER (FORSKAL.).





AMIA ELIZABETHÆ JORDAN AND SEALE. TYPE.

Jordan and Seale—Fishes From Hong Kong.



EPINEPHELUS MOARA (SCHLEGEL).

Jordan and Seale—Fishes From Hong Kong.

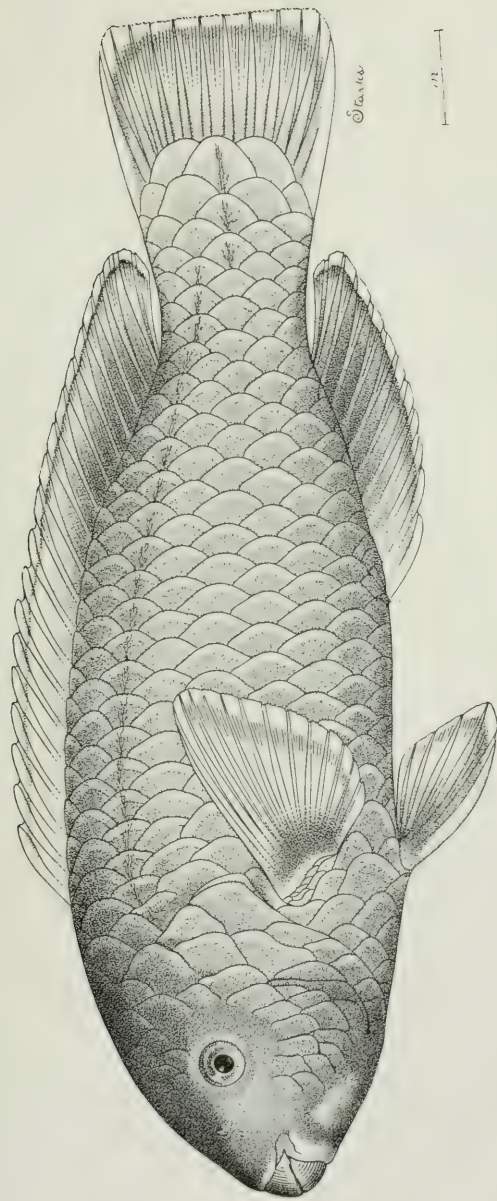
Dav. Acad. Sci.



HELIOTYPE COMPANY, BOSTON

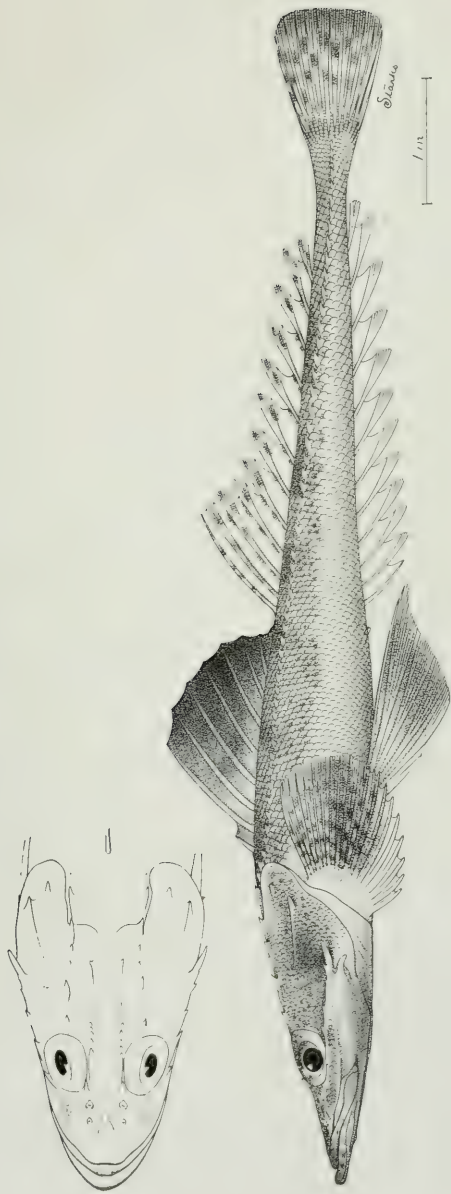
AMPHIPRION POLYMNUS (LINNÆUS).

Jordan and Seale—Fishes From Hong Kong
Atkinson, Del.



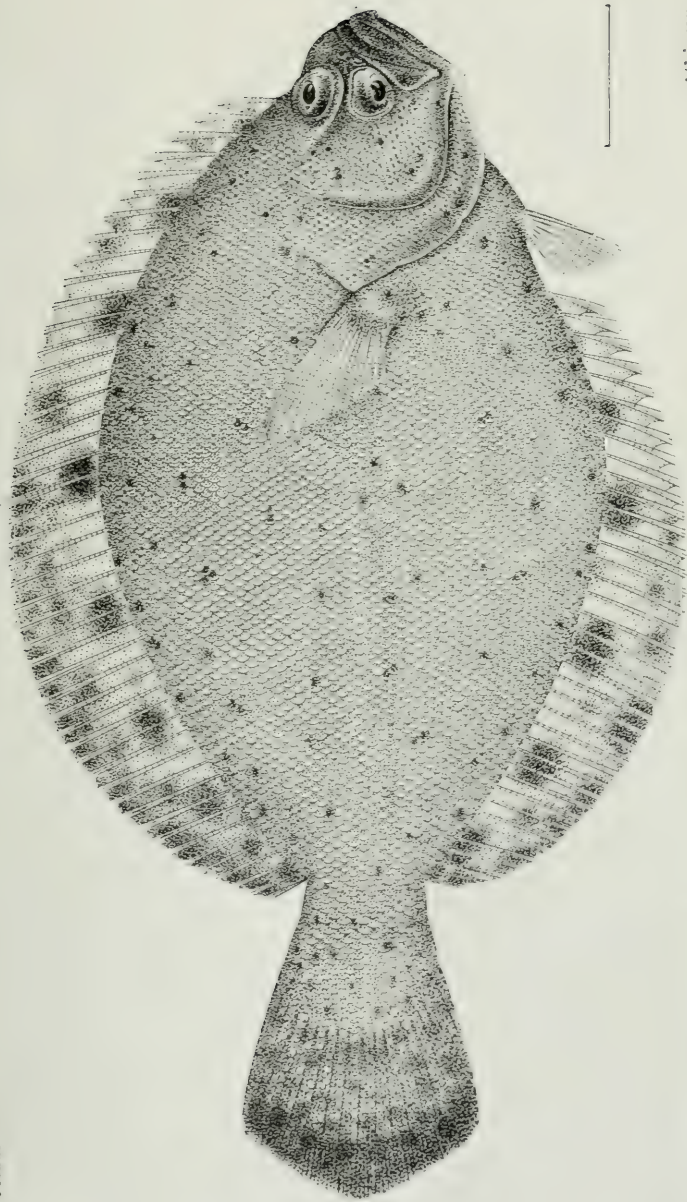
CALLYODON LIMBATUS (RICHARDSON).

Jordan and Seale—Fishes From Hong Kong.



INSIDIATOR NEGLECTUS (TROSCHL).

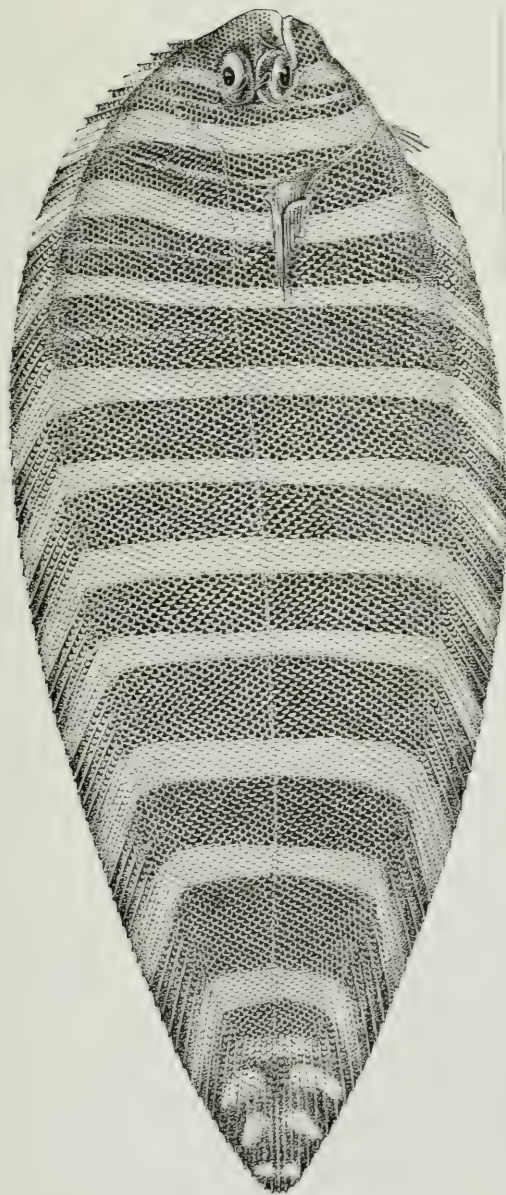
Jordan and Seale—Fishes From Hong Kong.



Atkinson, Del.

TETRARCTUS SINENSIS (LACÉPÈDE).

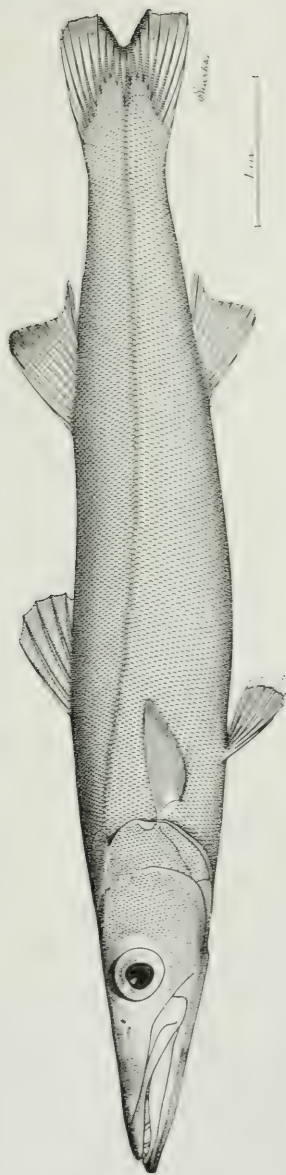
Jordan and Seale—Fishes From Hong Kong.



Atkinson, Del.

ZEBRIAS ZEBRA (BLOCH).

Jordan and Seale—Fishes From Hong Kong.



SPILARGIS PUTNAMII; JORDAN AND SEALE. TYPE.

Jordan and Seale—Fishes From Hong Kong.

Family APOGONICHTHYIDÆ.

24. *Amia elizabethæ* Jordan and Seale, new species. (Plate 4).

Head 2.75 in length; depth 2.75; eye 3 in head; scales 26; D. VII-I, 9; A. II, 8; small teeth on jaws, vomer and palatines; posterior limb only of preopercle serrated; lateral line complete.

Color, in spirits, yellowish white, with two faint longitudinal lines on each side, the most distinct on from snout, through eye to tip of caudal; black line through base of soft dorsal and of anal, soft dorsal and ventrals tipped with black.

One specimen, No. 9064 Stanford University. Length 3 inches.

This pretty species is named in honor of Miss Elizabeth Putnam in recognition of her deep interest in biological research.

Family SERRANIDÆ.

25. *Diploprion bifasciatus* (Kuhl and Van Hasselt).

Head 2.90 in length; depth 2.20; D. VIII., 14; A. II., 12; opercle with two strong spines, lower margins of opercles and preopercles toothed.

Color, in spirits, yellowish white, with two broad black bands; one over nuchal region through eye, the other on posterior of dorsal fin to soft dorsal obliquely down to origin of anal and posterior of belly; ventrals dusky, other fins except spinous dorsal, yellow.

Two specimens. Length about 6.25 inches.

26. *Epinephelus moara* (Schlegel). (Plate 5).

Head 2.50 in length; depth 4.20; eye 6.10 in head; D. XI., 13; A. III., 8; maxillary reaching to beyond posterior margin of eye; preopercle denticulate with rather strong teeth at angle; teeth on jaws, vomer and palatines, with some canines in jaws.

Color dull grayish with darker lines on opercle, 4-5 dusky vertical bars on posterior of body, more or less broken up and sloping towards head anteriorly; fins more or less shaded with dusky.

Three specimens. Length 5.50-6 inches.

This species has been wrongly confounded with *Epinephelus nebulosus*, by Dr. Boulenger (Cat. Fishes, I., p. 240).

Family PRIACANTHIDÆ.

27. *Priacanthus tayenus* Richardson.

Head 3 in body; depth 3; eye 2.10 in head; D. X.; 12; A. 13. Color, in spirits, silvery; ventrals black at tip, the ventral membranes with round purplish black spots, a large one near the belly. One specimen. Length 3.75 inches. It agrees well with Dr. Boulenger's description.

Family LUTIANIDÆ.

28. *Lutianus vitta* (Quoy and Gaimard).

Head 2.75 in length; depth 3.15; scales 52; D. X, 13; A. III, 7; a distinct black stripe from tip of snout through eye to caudal, an oblique narrow line on each row of scales above the lateral line and a longitudinal narrow line in each row of scales below this black band, with an indistinct spot on beginning of posterior third of the band.

Three specimens. Length 4.50-8 inches.

29. *Lutianus johnii* (Bloch).

Head 2.50 in body; depth 2.95; eye 5 in head; maxillary extending to anterior third of eye; D. X, 14; A. III, 8; scales 9-48-14.

Color, in spirits, silvery, slightly darker above, with oblique lines of scales above lateral line and longitudinal below, a large black spot on lateral line under the anterior of soft dorsal fin, a black blotch at axis of pectorals.

One fine specimen. Length 18 inches.

This specimen, evidently an adult, has but a shallow notch to preopercle and the knob of the interopercle is almost obsolete: the denticulations are stronger below the angle.

Family SPARIDÆ.

30. *Sparus sarba* Forskål.

(*Sparus latus* Houttuyn; *Chrysophrys aries* Schlegel).

Head 3.20 in body; depth 2.10; eye 3.75 in head; scales 6-64-11; D. XI, 13; A. III, 11; the second and third anal spines are equal, the second much stronger; molar teeth in three rows in each jaw, incisor rather strong and sharp.

Color, in spirits, a distinct black spot on first four scales of lateral line, color yellowish white, each scale with a brownish center giving the appearance of narrow brown longitudinal lines on body; a flaring white line from posterior axil of dorsal to below middle of spinous dorsal.

Two specimens. Length 9 inches.

These are not, evidently, different from Japanese specimens of *Sparus latus*. The black shoulder-spot, according to Dr. Day, is not found in *Sparus sarba*. It is, however, distinct in our specimens.

Family SCIÆNIDÆ.

31. *Johnius carutta* Bloch.

Head 3.30 in length; depth 3.75; eye 4 in head; snout equal to eye; no enlarged inner teeth; D. X-I, 29; A. II, 7; maxillary extending to below middle of eye; snout extending beyond mouth.

Color yellowish, a diffuse dusky blotch on opercle; spinous dorsal shaded with dusky; other fins yellowish.

Two specimens. Length about 5.75 inches.

32. *Pseudosciæna undovittata* Jordan and Seale, new species.

(Plate 6).

Head 3.50 in length; depth 3.75; eye 5.50 in head; D. X, 33; A. II, 8; scales 6-60; snout about equal to orbit; interorbital equal to orbit; distal end of maxillary extending slightly beyond posterior border of orbit. Body oblong, compressed, widest and deepest at origin of dorsal; entire body and head scaled except maxillary and lower jaw; the scales running in oblique series; depth of caudal peduncle half its length; upper limb of preopercle not denticulate; three or four small points on lower limb which are normally covered by scales; the upper limb of preopercle extends back from the vertical so that its rounded posterior margin is on a line with origin of lateral line; opercle with one small flat spine, with the membranous flap extending much beyond the spine; the tip of the snout is not very thick nor bluntly rounded as in *Sciæna*; mouth large, the lower jaw 1.98 in head; two small mucous pores on each side of lower jaw at tip; lips consisting of a rather distinct fold extending entire width of mouth; teeth of upper jaw consisting anteriorly of a single row of well separated

distinct rounded sharp teeth, the ones on each side of symphysis not larger than the others; posteriorly the teeth become small and merge into a band of villiform teeth in posterior third of jaw; teeth of lower jaw sharp and distinct, with outer scattered villiform teeth among the larger ones, a cluster of small teeth at symphysis, with two stronger curved teeth directed backwards; origin of dorsal fin on line with origin of pectorals, the two dorsals scarcely distinct; third dorsal spine the longest; pectorals 1-20 in head; base of anal 2.25 in head, being about equal to its longest anal ray; second anal spine weak, about 3 in length of longest anal ray, the spine smooth; the origin of anal midway between base of caudal and axil of ventrals; ventrals very close together, their length 1.50 in head; caudal rhomboidal, 1.50 in head.

Color, in spirits, yellowish white, the scales below the lateral line with yellow centers, which give the appearance of wavy oblique yellow streaks on lower sides of body; an indistinct small black spot at axil of pectorals; caudal and dorsal with slight wash of grayish; fins otherwise uniform.

One fine specimen from Hong Kong, No. 9065 Stanford University. Length 11.50 inches.

This may be the species called *Silurus crenatus* by Richardson, but the scanty description fails to apply well to our specimen. Our specimen has something in common with *Pseudosciaena amblyops* of Bleeker, but is apparently distinct.

Family SILLAGINIDÆ.

33. *Sillago sihama* (Forskål).

One specimen. Length 9.85 inches.

Family OPHICEPHALIDÆ.

34. *Ophicephalus naculatus* (Lacépède).

Head 2.90 in body; depth 5; eye 2.75 in head; D. 45; A. 30; scales about 58; maxillary extending to posterior of eye. Ventral fin present; twelve series of scales between orbit and angle of opercles; scales of head small.

Color, in spirits, grayish olive, with two series of irregular dark blotches with light edges. two irregular dusky lines from eye, one continuing along the side, the other to base of pectorals.

Two specimens. Length 8.50 to 9 inches.

Family POMACENTRIDÆ.

35. *Amphiprion polymnus* (Linnæus). (Plate 7).

We present a plate of this handsomely colored species from the reefs at Hong Kong. *Amphiprion japonicus* Schlegel is identical with *Amphiprion polymnus*.

Family LABRIDÆ.

36. *Charops cyanostola* (Richardson).

(*Charops ommopterus* (Richardson).)

Head 3 in body; depth 2.30; eye 6.30 in head; D. XII, 7; A. III, 11; scales 4-31-9; curved canines in front of jaws; scattered scales on sides of cheeks; ventrals not prolonged, not reaching anal; posterior dorsal and anal not elongate; caudal square.

Color, in spirits, dull yellowish brown; a black spot on scales of dorsal sheath at origin of soft dorsal; a dusky line from eye to eye of snout; another from angle of face to posterior edge of subopercle; fins grayish; no white spot below black spot in the back.

One specimen. Length 10.75 inches.

According to Dr. Günther the type specimen of Richardson's *Cossyphus cyanostola* is identical with his *Cossyphus ommopterus*, described on the next page. This is probably not the same as Bleeker's *Charops schomburgkii*, which species has a large yellow spot behind and below the dark one on the base of the dorsal. Bleeker's species is probably Cartier's *Charops unimaculata*. The original *Cossyphus schomburgkii* of Agassiz, from Celebes, is said to be uniform in color and is probably a distinct species, as already indicated by us in a paper on the fishes of Negros Island.

Family SCARICHTHYIDÆ.

37. *Callyodon limbatus* (Richardson). (Plate 8).

Head 3 in body; depth 3.10; eye 6.80 in head; teeth green, no posterior canine; three rows of scales on cheeks, the middle of six, the lower of two scales, which in part cover the lower limb of preopercle; caudal square.

Color, in spirits, purplish; spinous dorsal yellow; soft dorsal, anal and caudal with yellowish margin; lips yellow; ventrals with bluish band on outer third.

One specimen. Length 12.75 inches.

This specimen is different from *Scarus nuchipunctatus* Cuv. and Val. It is barely possible but not probable that *Scarus oviceps* Schlegel may prove to be based on a large example of the same species.

Family EPHIPPIDÆ.

38. *Drepane punctata* (Gmelin).

Head 3 in length; depth 1.10; D. IX, 20; A. III, 18; several small barbels on chin.

Color, in spirits, silvery, with seven to eight vertical rows of dark dots extending to a little below middle of body.

One specimen. Length 6.75 inches.

Of the various writers who have mentioned this species, but one, Mr. Cloudsley Rutter, has noticed the barbels at the chin.

Family MONACANTHIDÆ.

39. *Monacanthus chinensis* (Bloch).

Head 3.50 in length; depth 2; D. I, 29; A. 29. Two rows of large spines, of three spines in each row, on the sides of the caudal peduncle; dorsal spine with but two rows of barbs; the fan-shaped membranous portion of the ventrals extending much beyond the movable spine, dorsal and anal with numerous fine dark longitudinal lines, ventral dusky; body gray.

One fine specimen. Length 9.50 inches.

Family TETRAODONTIDÆ.

40. *Spheroides lunaris* (Bloch).

Head 3 in length; depth 3.30; eye 4 in head. Spinules on back from the snout to dorsal fin, and on belly from chin to anal opening; remainder of body smooth; fins yellowish-white; caudal lunate.

Two specimens. Length 5.20 to 8.75 inches.

Family SCORPÆNIDÆ.

41. *Sebastiscus marmoratus* (Cuv. and Val.).

Head 2.50 in length; depth 2.95; D. XII, 12; A. III, 5; 96 pores in lateral line; maxillary reaching to below middle of eye.

Color, in spirits, yellowish, marbled with dusky on sides and back; five lighter spots on base of dorsal; fins more or less blotched or dotted with dusky.

Two specimens. Length 4.30 to 4.35 inches.

Family PLATYCEPHALIDÆ.

42. *Platycephalus insidicator* (Forskål).

Head 3.10 in length; depth 9; lateral line smooth; two spines at angle of preopercle; scales about 110.

Color, in spirits, with about eight to nine dusky bars over back; fins with rows of dusky spots, except caudal, which has a medial longitudinal black band and two oblique ones on each side of the middle band.

One specimen. Length 15 inches.

43. *Insidiator neglectus* (Troschel). (Plate 9).

Head 3.50 in length; depth 8.3, eye 5.50 in head; D. I, VIII, I; A. 12; 53 armed scales in lateral line; three spines at angle of preopercle; head spinous; maxillary extending to below middle of eye.

Color, in spirits, brownish above with indistinct dusky bands, white below; spinous dorsal dusky; soft dorsal, caudal and upper half of pectoral with brown spots; lower half of pectorals plain black; tips of ventrals dusky; anal white.

One specimen.

44. *Insidiator detrusus* Jordan and Seale, new species. (Plate 10).

Head 3; depth 7.75 in length (without caudal); eye 4 in head; interorbital space 3 in eye; D. I, VII, 11; A. 12; scales 54; no spines on lateral line; two spines at angle of preopercle, the upper one long and strong, equal to two-thirds of eye, the lower one small; there is a minute superimposed spine on base of the long spine; a spinous ridge below the eye to base of preopercular spine with three strong backward-directed spines; a small blunt spine directly in front of eye and another one sides of snout; two very small spines on middle of snout. A short dermal flap at nostrils; superorbital spinous; a row of five distinct spines from posterior of eye to origin of lateral line; three sets of spines on nuchal

region counting the set immediately behind eye; two spines at posterior margin of opercles; head flat and wide, its width at base of preopercular spine 1.50 in head; lower jaw produced; maxillary equal in length to postocular part of head; villiform teeth in jaws, vomer and palatines; tongue trilobed as usual in *Insidiator*; origin of dorsal directly above origin of ventrals, the fourth dorsal spine the longest, 2.75 in head; base of anal equal to length of head without lower jaw; base of soft dorsal 1.20 in head; pectorals 1.80 in head; ventrals 1.75 in head; caudal rounded, 1.75 in head.

Color, in spirits, yellowish brown, with about five indistinct dark bands over back, one at origin of spinous dorsal, one at middle of spinous dorsal; one between spinous dorsal and soft dorsal; one at posterior third of soft dorsal and one on caudal peduncle; third and fourth are close together. Head with some scattered dusky blotches; spinous dorsal dusky, with deep black blotch between second and third spine and on the posterior margin of fins; soft dorsal with dusky blotch at anterior base between first and second rays, and with a small brown dot on other portion of fins; caudal plain with dusky wash on posterior half; ventrals and pectorals black, the pectorals with some lighter shade on center and at lower part of fin.

One specimen. No. 9067, Stanford University. Length 5.10 inches is type of the species.

In markings and general appearance one might easily mistake this species for *Platycephalus punctatus*, but the difference in the number of scales on the side is fully half a hundred.

Family PLEURONECTIDÆ.

45. *Tephritis sinensis* (Lacépède). (Plate 11).

Head 3.50 in length; depth 2; D. 45; A. 38; scales 94; mouth large, with several rows of small sharp pointed teeth in each jaw; eye 6 in head, very close together; interorbital space with a few scales; lateral line with a strong curve; the anterior rays of the dorsal and anal widest; ventrals short; caudal rounded, long; eyes on right side.

Color, in spirits, brown, with several black spots over body; fins blotched or shaded with dusky, with some black spots; tip of caudal black.

Two fine specimens. Length 9 to 10 inches.

In both examples the eyes and color are on the right side, which is probably the normal position in the species.

46. *Pseudorhombus cinnamomeus* (Schlegel).

Head 3.50 in length; depth 2.10; eye 5.50; lateral line strongly bent and a short curved branch or extension extending up to dorsal fin at top of head; maxillary extending to below posterior part of eye; the eyes close together; snout less than orbit; rather strong canine teeth in jaws. D. 80; scales about 86.

Color, in spirits, yellowish white, a distinct black spot at the point where lateral line becomes straight.

One young specimen of this common Japanese species. Length 4.25 inches.

Family SOLEIDÆ.

47. *Zebrias zebra* (Bloch). (Plate 12).

(*Esopia quagga* Kaup.)

Head 4 in length; depth 2.80

Twelve black cross-bands over the body; three or four of the anterior bands appear more or less double; the black bands extend in anal and dorsal; some whitish blotches on caudal, yellow in life.

One specimen. Length 4 inches.

There is no evidence, so far as we know, that this Chinese species occurs in Japan.

48. *Cynoglossus arel* (Bloch and Schneider).

Head 4.75 in length; depth 4.25; eye 4.50 in snout; interorbital 6 in snout; D. 120; scales 96; snout 2.30 in head. Two lateral lines; eight rows of scales between them at the greatest distance apart.

Color, in spirits, dull whitish; the dorsal and anal dusky.

This fish seems to agree very closely with Dr. Day's description and figure of *Cynoglossus arel* but it differs markedly in having a much larger eye and a rather more pointed snout. Unless the very small size of the eye in Day's figure is fallacious, as we suppose, the Hong Kong specimen represents a new species.

The Aftonian Gravels, and Their Relations to the Drift Sheets in the Region About Afton Junction and Thayer.

BY SAMUEL CALVIN.

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The Importance of the Region.—The glacial deposits of Iowa constitute by far the most important of the geological formations with which our highly favored state is endowed; and hence it is that all problems relating to the structure, genesis and age of these deposits are invested with a high degree of practical, as well as of purely scientific interest. Questions concerning the drift probably admit of a clearer and more satisfactory answer in Iowa than anywhere else on this continent, and the region about Afton Junction and Thayer has become classic for the reason that here the facilities for obtaining answers to some of the more interesting and significant of these questions are not surpassed, if indeed they are equalled, in any other locality in the world. Some of the most eminent students of glacial phenomena, both of Europe and America, among whom may be mentioned Penck of Vienna, McGee of Washington and Chamberlin of Chicago, have availed themselves of the rare opportunities for successful investigation which the region affords. A bed of regularly stratified sand and gravel, a true aqueous deposit more than forty

feet in thickness, is here found covering an area of considerable size and lying between two distinct sheets of glacial drift. Associated with the gravels are indications of a long interglacial interval, the evidence being expressed in the form of weathering, oxidation, leaching and general alteration of the deposits exposed. Then there are beds of peat and remains of forests which flourished during the interval in question, and these fortify and confirm the evidence from mere change in the inorganic materials. The aqueous deposits have been called Aftonian gravels, the organic accumulations are referred to as the Aftonian peat and forest beds, and the time between the disappearance of the ice sheet which deposited the first bed of drift, and the advent of the glaciers which distributed the second drift mantle, is known as the Aftonian interglacial interval. The phenomena, as they were revealed a few years ago, have been described more or less fully by Chamberlin in the *Journal of Geology*, and by Bain in the *Proceedings of the Iowa Academy of Sciences*; and the term Aftonian has taken permanent place in geological literature as the name of one of the important divisions of the glacial epoch. Recently, however, opportunities for further study have been greatly enlarged on account of the extensive improvements carried out by the C., B. & Q. railway. A number of cuts, ranging from a few feet to more than sixty feet in depth, have been made, exposing fresh sections of the glacial deposits, and revealing with a degree of clearness before unknown the true relations of the different members belonging to the lower part of the Pleistocene series. The cuts were examined when they were fresh, and on several occasions since they have been visited by parties of geologists; but slumping, overwash and erosion on the one hand, and growth of vegetation on the other, are rapidly modifying the face of the sections and obscuring the facts which they at first revealed. It seemed desirable, therefore, that the opportunities for observation should be seized while they were yet available, and that the results should be made a matter of permanent record.

Some Factors of the Problem.—The effects of five distinct glacial invasions have been recognized in Iowa, and the corresponding sheets of drift, in the order of age, have been named respectively

the Sub-Aftonian or Pre-Kansan, the Kansan, the Illinoian, the Iowan and the Wisconsin. The problems presented by the region under discussion relate chiefly to the first and second of the drift sheets and to the records of the interglacial interval by which they were separated, but there are here also some deposits which are possibly referable to the Iowan, or fourth stage of glaciation. So far as our own state is concerned, the oldest recognized glacial deposit, the pre-Kansan drift, is not surficial over any definite area. Studies near the glacial border in Missouri, Kansas and Nebraska may reveal the presence of a marginal area in which the old pre-Kansan has not been concealed by later formations; but at present no such area is known, and in Iowa, at least, the till distributed by the second glacial invasion completely covered the mantle of detritus left by the first. Our oldest till, therefore, is now seen only where it has been exposed by erosion or by the making of artificial excavations. The best natural exposures of the pre-Kansan, so far noted, are found in the bluffs on the right bank of the Grand river, about one mile south of Afton Junction. At this point the old glacial drift is overlain by the extensive accumulations of stratified sand and gravel, referred to above, and these are themselves overlain by from twenty to thirty feet of very much weathered material belonging to the age of the second ice invasion, the Kansan. The gravels have been worked extensively for railroad ballast. At an exposure one mile south of Afton Junction the beds have been removed over an area of several acres. Another large pit covering a similar area was opened and worked a few rods southwest of the present Great Western crossing at Afton Junction. A third pit, equally large, was worked near Thayer. Bain refers to these as the Grand River, Afton Junction, and Thayer pits respectively. The underlying pre-Kansan drift is now seen only at the first; the overlying weathered Kansan is well developed at all three. That the sands and gravels of these pits are aqueous in origin, admits of no question. The materials are more or less perfectly assorted and are somewhat regularly stratified (Fig. 1.) When they were laid down, the glacial conditions which gave rise first to the lower drift sheet and afterwards to the overlying Kansan, did not exist. As to their age it is certain that they are younger than the sub-Aftonian till, and they

are probably older than the Kansan; but the precise age was not regarded by Bain as more definitely settled by the evidence of the exposures available for study prior to the year 1898. Bain's studies, therefore, left the question of age somewhat unsettled. There are three possibilities. (1) The gravels may have been laid down along drainage courses by waters flowing away from the melting and retreating margin of the pre-Kansan ice, upon a surface which, but a short time before, had been left bare by the gradually waning glaciers. On this hypothesis the gravels are but little younger than the till upon which they rest. Their materials were derived from the detritus carried by the older ice sheet; they represent simply the closing phase of the sub-Aftonian or pre-Kansan stage of glaciation. (2.) The gravels may have been deposited by waters flowing out in front of the advancing Kansan ice, in which case they were laid down upon the eroded and weathered surface of the pre-Kansan till. If this be the true hypothesis, the materials should bear evidence of having been derived from the detritus carried by the Kansan glaciers, and the gravels would be but little older than the great sheet of Kansan drift beneath which they were, after their deposition, almost immediately buried. They would represent, for this latitude, the initial phase of the Kansan stage of glaciation. (3.) The gravels may have been deposited by floods which were in no way related to glacial conditions, and these floods may have occurred at any time during the long interval of mild climate which separated the pre-Kansan glacial stage from the Kansan. Which of the three possible hypotheses is correct?

Facts Bearing on the Solution of the Problem.—It is an interesting fact that the several drift sheets of Iowa differ among themselves in their physical characteristics, such as color, texture and composition, as well as in age; and it is between two sheets of drift possessing very distinctive physical properties that the waterlaid Aftonian sands and gravels lie. The sub-Aftonian or pre-Kansan till is a dark colored, fine grained deposit which becomes friable or pulverulent on drying. It is not jointed in any marked degree. On the other hand the Kansan till which overlies the gravels is normally blue or gray in color; it is a stiff clay which becomes profoundly and extensively jointed; and it dries

into hard, many-sided blocks as firm and resistant as the hardest of dried clods or sunbaked bricks. The rock fragments included in the two beds of glacial clay present great differences. The Kansan is much the richer in quartzites and green stones; the pre-Kansan is richer in granites some of which are of the coarse feldspathic type so characteristic of the Iowan drift in the north-eastern part of the state. Rock fragments are far more numerous in the Kansan than in the older till, but clear quartz sand mixed with the soft black clay is a distinguishing feature of the pre-Kansan. There are also, in the black pre-Kansan clay, numerous small pockets of yellow or orange colored sand, one-half inch to an inch in diameter, which are unknown in any of the other drift sheets of Iowa.

Now it is a fact that the coarse feldspathic granites of the sub-Aftonian till are common among the cobbles and pebbles of the Aftonian deposit, while greenstones and basalts are relatively scarce. Many of the granites are in an advanced state of decay, as shown in (Fig. 2.) Here a boulder originally more than a foot in diameter has rolled down from the breast of the gravel pit and is rapidly crumbling into sand. It is also true that the few greenstones present show much more change than is usually seen in cobbles of the same type when occurring even near the surface of the Kansan. An altered outer zone, three-eighths of an inch in thickness, is a prominent characteristic of the fractured surface when specimens are broken. Another fact of great significance is found in the highly ferruginous and profoundly weathered zone of the gravels immediately below their contact with the overlying Kansan till. This feature is especially well developed in the Thayer pit. It indicates very clearly prolonged exposure of the surface before the protecting covering of Kansan drift had been laid down upon it. A well developed soil band with traces of leaves and fragments of wood, between the upper surface of the gravels and the Kansan till, has been reported by Chamberlin and others who visited the locality before washing and sliding of the materials had concealed important details of the section. All the known facts lend support to the view that the Aftonian gravels were in place and had been profoundly altered and weathered by long ages of exposure before the arrival and deposition of the Kansan drift. The materials making up

the Aftonian gravels are certainly not of Kansan origin. The second hypothesis is untenable.

Concerning the third hypothesis, it may be enough to say that, so far as relates to the interval between the complete melting of the pre-Kansan and the incursion of the Kansan ice, there is no way at present known to account for floods of volume and duration sufficient to transport and deposit the great beds which make up the Aftonian formation. In the analogous case of the Buchanan gravels so extensively distributed throughout north-eastern Iowa, there are indications which point unquestionably to their transportation and deposition by great floods liberated by the melting of the Kansan glaciers. The melting of the pre-Kansan glaciers certainly gave rise to similar floods, and it is safe to assume that these were the agents whereby the Aftonian gravels were carried and deposited. These beds bear to the pre-Kansan drift exactly the same relation that the Buchanan gravels bear to the later Kansan. There are very few points where the contact of the Aftonian gravels with the underlying pre-Kansan drift is exposed, and so it cannot positively be affirmed as a conclusion based on actual observation, that there are no indications of an erosion interval and uncomformity between them; but it may be said that at the few points where the contact is seen, there are no signs of weathering such as would have occurred if the upper surface of the pre-Kansan drift had been exposed for any considerable period before the Aftonian gravels were deposited. The weathering and other signs of age and long exposure are limited to the gravels, and chiefly to the upper part of the gravels. That these were profoundly altered before being covered and hermetically sealed by the overlying Kansan drift, is a fact everywhere apparent.

When the relations of the Aftonian gravels to the drift deposits of the region under consideration were studied by Bain, the opportunities for observation were very meager, and he was greatly puzzled by the fact that, at several points, beds of gravel, apparently undisturbed, seemed to pass by lateral transition into "boulder clay undistinguishable from, and apparently connected with, the overlying Kansan." This seemed to him to argue a contemporaneity of age*, but he wisely left the question open

*Proc. Iowa Acad. of Sciences, Vol. V, p. 97, Des Moines, 1898.

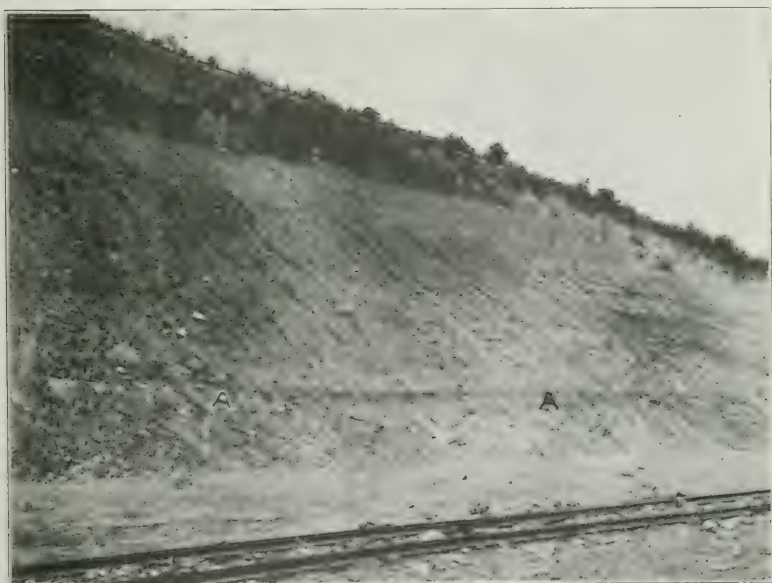
for further investigation. The great cuts made in connection with the new work on the C., B. & Q. railway have furnished the opportunity to which he looked forward. The relations of the gravel as a whole to the associated sheets of drift are no longer in doubt; the lateral transition of gravel into Kansan boulder clay, so apparently inexplicable when seen in a few imperfect sections, is now a matter admitting of simple and satisfactory explanation.

The Records of the New Sections at Afton Junction and their Interpretation.—A few rods west of the Great Western crossing the new line of the Burlington road passes close to the northern edge of the old Afton Junction gravel pit as shown in figure 3, and the grade, fortunately, is a few feet below the contact of the gravels with the overlying Kansan drift. The relations of the two formations are very clearly shown throughout the whole length of the space included in the figure, but it is in the cut at the extreme left of figure 3, that the most instructive phenomena of this locality may be studied. The coarser gravels making up the main body of the Aftonian deposits grade toward the top into rather fine, evenly bedded sand. When the cut was fresh, and before the carefully sloped sides had been modified by rain wash, the sharp line which separates the regularly stratified sands from the later drift, was very distinct, especially if investigated at close range. The camera does the subject only partial justice, but in figure 4 the line A A marks the division between the aqueous deposits of Aftonian age and the later glacial deposits of the Kansan. There are here no indications of transition of one into the other. The line of separation is clearly and sharply defined, and its marked regularity gives the appearance of perfect conformity between the two formations. One year later the cut was visited again, and in the mean time weathering had brought out some features not previously observed. In places the loosed Aftonian sands had fallen away, as shown in figure 5, and left recesses ranging from ten to eighteen inches in horizontal dimensions beneath the more persistent boulder clay. A firmly cemented ferruginous crust, from one-half inch, or less, to an inch in thickness, showing somewhat distinctly in figure 5, forms a cap to the Aftonian sand. The caving and washing of



Calvin-- The Aftonian Gravels.

Figs. 1 and 2



Galvin—The Astonian Gravels.

Figs. 3 and 4.



Galvin—The Aftonian Gravels.

Figs. 5 and 6.



Calvin —The Aftonian Gravels.

Figs. 7 and 8.



Calvin - The Aftonian Gravels.

Figs. 9 and 10.



Calvin—The Astonian Gravels.

Figs. 11 and 12.



Galvin—The Aftonian Gravels.

Figs. 13 and 14.

the sand leaves the crust unsupported, and slabs of it, several inches in length and width, may be found broken loose from the overlying till. Now the upper surface of this crust is uniformly marked with parallel grooves and ridges resembling in every particular the effects of glacial planing (Fig. 6). The striæ have a direction a few degrees west of south, a direction that agrees well with many glacial scorings on the limestones of southwestern Iowa.

The boulder clay which here overlies the sand and gravel, is what is known in recent geological literature as the Kansan. It is overlain by a veneer of loess (Fig. 7) which is much younger than the till, for before the loess was deposited the old drift surface had been carved by drainage waters into a system of hills and valleys showing unusually high relief for a drift-covered region. As a matter of fact the loess forms a covering of nearly uniform thickness over the hill slopes of a pre-loessial, erosional topography. During the period of erosion winds and storm waters removed the finer constituents of the drift from the surface and left a bed of residual gravel composed of the coarser materials, not so easily removed. As is well shown in figure 7, it was on an eroded surface covered with a sheet of residual gravel that the loess, in one of the later stages of the Pleistocene, was laid down. The loess is comparatively young and fresh, but the drift below it shows signs of greater age in extensive oxidation and other forms of alteration due to long pre-loessial exposure to the weather. Along the numerous joints which here, as elsewhere, characterize the Kansan till, the weathering has proceeded to depths of thirty or forty feet. These joints afforded ready passage ways for the circulating ground waters, and many of them are marked by trains and aggregations of lime nodules (Fig. 8), the materials of which had been leached from the upper part of the formation and re-deposited as concretions along the courses followed by the underground drainage. As pointed out by Bain in the Proceedings of the Iowa Academy of Sciences, Vol. V, pp. 94 and 95, and shown indistinctly in figure 4, there are faint traces of stratification in the Kansan till, but at the sections here under consideration there are no signs of transition from Aftonian to Kansan, from aqueous to glacial deposits.

Three questions are suggested by a study of the relations of

the Aftonian to the Kansan, shown in figures 4 and 5. *First*, does that even, straight line of demarcation between the two formations indicate that the drift was laid down conformably on an uneroded surface of Aftonian? *Second*, how was it possible for the ponderous Kansan glaciers to move over the loose Aftonian sands without plowing into them, destroying them, and mixing them with the detrital sub-glacial material carried by the ice? *Third*, what is the significance of the remarkable ferruginous crust (Fig 6), on top of the sand, with its parallel grooves and ridges simulating in such a striking way the effects of glacial planing? It is the purpose, at present, only to suggest possible answers to these questions. It is conceivable that the surface of the Aftonian formation may have been more or less trenched and uneven before the advent of the Kansan glaciers, notwithstanding the present evidence that here at least it was practically a plane at the time the overlying drift was deposited. It is also conceivable that the sands were saturated with water, and that just before the glaciers reached this particular locality they were frozen solid. In this condition they would be able to resist glacial grinding as effectively as ordinary limestones or sandstones. It is also conceivable that the ice planed the frozen sands to an even and more or less level surface, and that this surface was marked by parallel grooves precisely as ordinary rocks were elsewhere affected by the passage of great sheets of glacier ice. When later, during the period of wasting and retreat of the Kansan glaciers, the ice was transformed from an agent of erosion to an agent of deposition, the stiff Kansan clay was molded into the grooves on the surface of the still frozen sand. In this way the glacial groovings would be preserved intact, and the line of junction between the two deposits would be true and straight as shown in figures 4 and 5. The explanation of the genesis of the ferruginous crust (Fig. 6) presents some difficulties. It is clear that waters carrying some compound of iron in solution moved toward the upper surface of the sand, and that iron oxide was precipitated in the thin layer in immediate contact with the glacial clays. That most of this was done after the railway excavation was finished is altogether possible. It is certain that, after the cut was made, evaporation would go on rapidly from the exposed surface of the sand beds

near the bottom of the slopes; and iron-bearing waters, moving vertically or laterally through the loose Aftonian deposits toward the evaporating surface, may, by evaporation and consequent precipitation of material held in solution, have caused the cementation of the sand into the firm crust under discussion. That this crust, however formed, should retain the markings due to glacial planing, need excite no surprise when all the circumstances and possible conditions are taken into account. Concretionary nodules, well illustrated along some of the ridges toward the right in figure 6, show quite clearly that the deposition of the cementing iron oxide took place after the planing and scoring of the surface had been accomplished. Furthermore, the crust has a nearly uniform thickness, the lower face maintaining in a general way a sort of parallelism with the upper, and roughly repeating in reverse the larger grooves and ridges. The crust has developed since glaciers planed the frozen sand.

The New Sections Near Thayer, Sand Bowlders.—One-fourth of a mile west of Thayer, in another of the new railway cuts, some significant facts in the Pleistocene history of the region are very clearly recorded. It is evident, from a study of the cuts west of Afton Junction, that, in some localities, the Kansan glaciers passed over the Aftonian sands and gravels without breaking them up, or disturbing them in any way. The ice simply planed and scored the surface precisely as it might have done, and as it actually did, in moving over a bed of New England granite, or over the crinoidal limestones of Des Moines county, Iowa. On the other hand, the sections revealed by the cut west of Thayer show that, in some instances at least, the Kansan glaciers plowed deeply into the frozen gravels, broke them up into great fragments, transported the frozen masses for longer or shorter distances, and deposited them as parts of the detrital material making up the mantle of Kansan drift. In this one cut, as shown in figures 9 to 13, there are scores of "sand bowlders" ranging from a few inches to more than one hundred feet in diameter. The solid blocks of frozen sand and gravel were moved as other ponderous rock masses have been transported by glacier ice. The original bedding was undisturbed in most instances. Occasionally the frozen block was fractured and

a certain amount of faulting took place along the shearing planes. In rare instances the boulders show effects of contortion and folding (Fig. 11); in other cases the mass was rotated through an arc sufficient to set the bedding planes at a high angle, a fact illustrated in figures 12 and 13; but not infrequently the bedding planes remain practically horizontal, as in the case of the very large body of transported gravel at the base of the slope in figure 10.

It is now possible to understand the cases reported by Bain, where Aftonian gravels seemed to give place, by more or less abrupt transition, to Kansan till, and the relations of the two kinds of material were such as to "argue contemporaneity of age."* The experience of the Great Western Railway Company, which began to open up a body of gravel and soon found that the steam shovel was handling nothing but boulder clay, might be repeated at the locality shown in figure 12. Here is a great body of excellent gravel, presenting a cross section more than one hundred feet in length and fully twenty feet in height, that, when the cut was fresh, looked like a section of a gravel kame. It is, however, nothing more than an unusually large sand boulder. Later weathering has shown that the enormous mass of gravel was tilted in the process of transportation so that the bedding planes stand at a high angle. In its history and its relations to the Kansan till, notwithstanding its great size, it does not differ from the smallest of the sand boulders shown in figures 9 and 10. If these were granite boulders, and not mere masses of stratified sand and gravel, instead of arguing contemporaneity of age, the relations would afford positive demonstration that the granite is older than the till in which it is incorporated. The sand boulders tell the same story concerning the relative age of the Aftonian and the Kansan, a story which is abundantly corroborated by the stratigraphic relations and other lines of evidence.

Boulders of Pre-Kansan Clay.—In the numerous sections of Kansan drift exposed by the new railway cuts between Thayer and Afton, boulders of pre-Kansan till, as well as boulders of Aftonian sands and gravels, are not infrequent. As hereinbe-

* The Aftonian and Pre-Kansan Deposits in Southwestern Iowa, by H. Foster Bain; Proc. Iowa Acad. of Sc., Vol. V, Des Moines, 1898.

fore noted, the lower till differs in color, texture and other physical properties from the overlying Kansan. It is a very dark clay which crumbles readily on drying, and this characteristic, together with its small pockets of yellow colored sand, renders it conspicuously distinct from the clays distributed by the second glacial invasion. At many points in the numerous exposures recently opened to investigation, imbedded in typical Kansan clays, there are masses of the dark sub-Aftonian till, with its pockets of yellow sand and other distinguishing characteristics. One of these, the body which makes up the dark prominent mass in the center of figure 14, shows evidence of having been rolled and kneaded in the process of transportation.

Summary of the Evidence.—The evidence now before us shows two things. First, in certain localities the Kansan ice rode over the older deposits without causing any break or disturbance, in which case the materials of the older formations occupy their proper stratigraphic relations to the newer Kansan till. Second, under certain conditions the glaciers of the Kansan stage plowed up the Aftonian and sub-Aftonian beds and incorporated masses, varying from a few inches to many feet in diameter, in the great sheet of Kansan drift. The evidence probably warrants a third statement to the effect that, when all the facts are taken into account, there is no transition of Aftonian gravels to Kansan clays and nothing that argues contemporaneity of age.

The Aftonian a Real Interglacial Interval.—That the Aftonian was a real interglacial interval of mild climate and of long duration, is demonstrated by the evidence of extensive peat beds and forests which developed on the surface of the pre-Kansan drift, and were later overwhelmed and buried by the glaciation of the Kansan stage. In McGee's *Pleistocene History of Northeastern Iowa*, in the Eleventh Annual Report of the United States Geological Survey, there are numerous references to a soil and forest bed which the author assumed to lie between his lower and upper till; but, as the Pleistocene deposits are now divided, the organic material would be referred, in practically every case there mentioned, to the Aftonian horizon. Similar evidence of a soil, peat and forest horizon beneath the Kansan drift is noted

in many of the county reports published in the volumes of the Iowa Geological Survey. On pages 54 to 68 of volume IV, *Proceedings of the Iowa Academy of Sciences*, there are detailed descriptions of the Aftonian peat bed in the classic section at Oelwein. The latest evidence of a long, mild interval between the pre-Kansan and the Kansan stages of glaciation is presented by Savage in his descriptions of a buried peat bed in Dodge township, Union county, Iowa, published in the *Proceedings of the Iowa Academy of Sciences*, volume XI.

DESCRIPTIONS OF FIGURES.

- Figure 1. South side of the gravel pit at Afton Junction, showing definite stratification.
- Figure 2. Decayed granite boulder which has fallen from the face of the excavation here made in Aftonian gravels and is undergoing rapid disintegration. The softened nucleus, ready to crumble to pieces on the slightest touch, is surrounded by a miniature talus of disintegrated fragments.
- Figure 3. The north side of the gravel pit at Afton Junction. View shows new railway grade, and the heavy body of Kansan till above the gravels.
- Figure 4. First cut west of the Afton Junction gravel pit showing the even line of contact, A A, between the Aftonian deposits and the Kansan till. View shows north side, and was taken when the cut was fresh, in August, 1901.
- Figure 5. South side of the cut illustrated in figure 4, as it appeared in August, 1902. The edge of the ferruginous crust and the effects of caving of the loose sand beneath it are seen at AA. The material above the contact line, A A, is Kansan till.
- Figure 6. Fragment of the ferruginous crust, one-half natural size, showing the straight parallel grooves and ridges on its upper surface.
- Figure 7. View showing thin sheet of residual gravel between loess and Kansan drift and illustrating the practical parallelism between the pre-loessial and the present topography. The loess is young as compared with the Kansan drift.
- Figure 8. The sloping side of the new cuts showing trains and aggregations of concretionary calcareous nodules along joints in the Kansan clay.
- Figure 9. South side of the first cut west of Thayer, showing numerous "bowlders" of Aftonian sand and gravel incorporated in the Kansan drift.
- Figure 10. A very large "sand bowlder" at the base of the cut, with others of smaller size; near Thayer.
- Figure 11. "Bowlder" of Aftonian sand, crumpled and folded, north side of cut near Thayer.
- Figure 12. A kamelike mass of the Aftonian, tilted in process of transportation.
- Figure 13. Portion of a large "sand bowlder" with beds slightly folded and inclined at a high angle.
- Figure 14. A "bowlder" of pre-Kansan. The prominent dark body in the center of the view is a rolled and contorted mass of the older drift embedded in the Kansan, while above it, and to the right, is a "gravel bowlder" from the Aftonian.

A Comparative Study of the Vegetation of Swamp, Clay, and Sandstone Areas in Western Wisconsin, Southeastern Minnesota, Northeastern, Central, and Southeastern Iowa.

BY L. H. PAMMEL.

In presenting this paper the writer has attempted to bring together certain interesting facts pertaining to the flora of a few isolated areas of Iowa, Wisconsin, and Minnesota, calling attention to the local distribution of some plants and their relation to the physiographic condition of the region.

In the year 1883, when a student at the University of Wisconsin, I began the study of the flora of southeastern Minnesota and western Wisconsin. A collection of plants was made, and added to from time to time since. Little, however, has been published on the flora that is interesting from a geographical standpoint. The local distribution of a few of these plants depends upon physiographic conditions peculiar to the region. Some time has also been spent in studying the flora of central Iowa. Here again we have some interesting local physiographic conditions, and a few plants that are local in their appearance. These rare plants are found upon the sub-carboniferous sandstone of the region. The writer has also had an opportunity to study the peculiar flora in Muscatine and Marion counties, with small outcrops of sandstone. These areas likewise contain plants that are in part quite local to the regions.

Published accounts of the flora of the regions named are not numerous. The best paper treating with the ecological aspects of the region is that by Prof. Wheeler on the flora of southeastern Minnesota.¹ Prof. Wheeler, however, made a study of Winnebago and Crooked creeks in Houston county only. After a brief discussion of the physiography of the region, Prof. Wheeler treats the formations under the following heads: Plankton; attached, submerged, aquatic plants; attached aquatic

1. Wheeler, W. A.—A Contribution to the Knowledge of the Flora of Southeastern Minnesota. Minn. Bot. Stud. 24: 353-416. Pl. 21-27.

plants with natant leaves; adaptive shore plants; wet meadows of the river valley, mud flat vegetation, creek valleys, cold spring vegetation, pond vegetation, wet vegetation of the creek valleys,

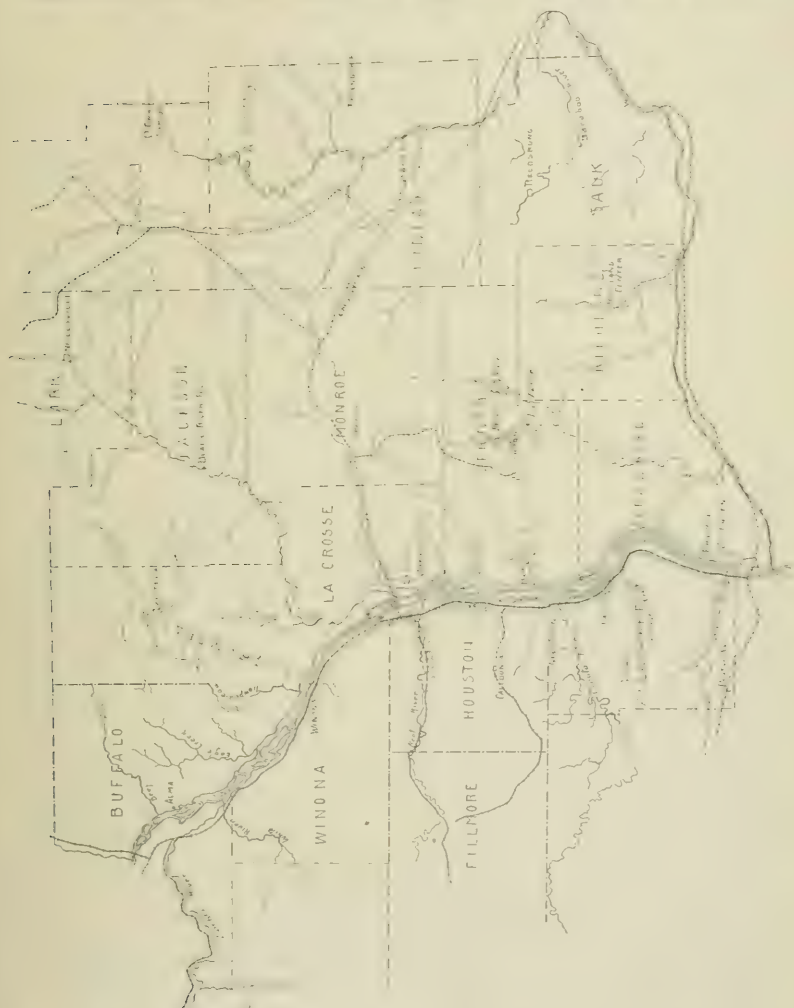


FIG. 1. Map of Western Wisconsin, Southeastern Minnesota and Northeastern Iowa.
Charlotte M. King.

moist wood vegetation, mesophytic field vegetation, moist cliff vegetation, vegetation of wooded slopes, ridge forest vegetation, base slope and open ridge vegetation and dry rock vegetation.

Lueders, in his account of the vegetation of the town of Prairie Du Sac, in Sauk county, as well as the paper by Dr. Parry, considers the physiographic conditions as having an important bearing on the distribution of plants. The paper by Wheeler gives a good analysis of the flora and of the different formations. The following systematic papers¹ should be mentioned: The paper by L. S. Cheney and R. H. True on the flora of Madison and vicinity, and papers by the writer and Prof. Greene, also papers by Prof. Macbride on trees and shrubs of Allamakee county.

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The paper by Dr. Fink on the Spermatophyta of Fayette, as well as notes by Shimek on the Aquatic Plants of Northern Iowa and Notes on the Flora of Iowa, and the paper by Cratty on the aquatic plants, touch upon interesting phases of the flora included in this article. The paper by Cameron on the Trees and Shrubs of Delaware County, and the very excellent paper by Barnes, Reppert and Miller on the Flora of Scott and Muscatine Counties touch upon the floras peculiar to some of the regions of the state.

For the sake of convenience, we will discuss the subject under the following heads: Topography, Geology, Climatology, Physical Properties of Soils, Chemical Properties, Bacteria of the Soil, Plant Formations, The Algal Flora, and Local Problems in Geographical Distribution.

TOPOGRAPHY.

WESTERN WISCONSIN, SOUTHEASTERN MINNESOTA AND NORTHEASTERN IOWA.

The region here considered is embraced in the counties of La Crosse, Trempleau, Vernon and part of Monroe. The region is well watered, containing several perennial streams of considerable size. The Black River rises northeastward and flows through a country once heavily timbered with white pine. The Kickapoo, with its several branches, rises in Monroe county where there are many swamps which are in part drained by the eastern part of the Kickapoo River, while the northern part of the county is swampy in many places and drained by the Lemonweir River, which flows into the Wisconsin River below Mauston.

The La Crosse is the smallest of the three streams. This rises in Monroe county and drains many small marshes, receiving numerous small brooks and creeks that rise in the hills adjacent to its valley. In part the river has made its way through a Jack-pine plain region near Sparta and small prairie-like openings.

In addition to these streams mention may be made of such streams as the Mormon Cooley, Chipmunk, State-road Cooley, Bostwick, and Smith's creeks and the Bad Axe and Coon rivers. In former times the Mormon, Bad Axe and Bostwick contained a much more even flow of water than at the present time. The

flow was more regular, since these streams had water sufficient to run flourishing flour mills during the entire year. The spring water comes from various sources, the best and largest springs coming from the St. Croix sandstone area. Another class rises below the Oneota limestone and the third class rises in the marshes and bogs.

Between La Crosse and Geneva, on the Wisconsin side of the Mississippi, precipitous bluffs face the river, having an elevation of 460 to 500 feet above the flood plain of that river. There are, however, bluffs to the north that are 600 feet above the Mississippi flood plain. The topography of the Minnesota side is essentially the same. There are a half-dozen small streams, the most important being the Root River and Pine Creek. By far the greatest volume of water, however, is carried by the Root River. The higher bluffs on both the Wisconsin and Minnesota sides are generally bare and very dry. The ridges are frequently long and always narrow. Eastward from the Mississippi the bluffs are less precipitous and the ridges widen into flat or rolling areas and these are of considerable size. To the south these areas are common, with quite deep valleys.¹

The rock exposure toward the Mississippi River consists mainly of St. Croix sandstone of great thickness, capped with a thin layer of Oneota. At the base of the bluffs toward the river are sandy plains; but the valleys vary greatly in width. The soil of the valleys consists of a yellow loam, but near the creeks and rivers it is a black alluvial. Bogs and marshes have formed under favorable conditions. North of La Crosse, and including the Black River district, the hills are low and sandy, often with deep ravines. The Black River district is a network of sloughs and marshes, but in the older flood plains is drier. Here there is a scattered growth of Norway pine, red cedar, swamp white oak and green ash. The sandy uplands often form low prairies of fair fertility. Swamps are, however, common also in other parts of the region. In part, these swamps are surrounded by low hills and terraces. Taking these meadows in the vicinity of La Crosse, close to the mouth of the river, as a typical illustration, we have a marshy plain and an elevated sandy prairie that rises between

1. Geol. of Wis. 4: 1.

thirty and forty feet above the flood plain of the La Crosse River. On the west side of the Mississippi, except in Houston county, there are swamps and marshes not unlike those on the east side of the river, but they are not nearly so extensive. The same may be said of Allamakee county in northeastern Iowa. At the mouth of Red River and Pine Creek in Minnesota there are extensive alluvial bottoms where soil of great fertility has formed. The back-waters of the Mississippi near the mouth of Pine Creek have



FIG. 2. Bluffs along the Mississippi River near Lansing, Iowa. Hard Maple, *Acer nigra*, on high bank. Basswood, *Tilia americana*, Black Walnut, *Juglans nigra*, on banks above the alluvium. Black Birch, *Betula nigra*, Cork Elm, *Ulmus racemosa*, Soft Maple, *Acer saccharinum*, on alluvium. Photograph by Charlotte M. King.

formed a lake of considerable size known as Target Lake. In the vicinity of La Crosse, and Houston, Minnesota, as well as New Albin in northeastern Iowa, there is a well-marked terrace formation.

Moses Strong¹ made three natural divisions in the Wisconsin area here considered. First, high, rolling table-land cut up by

1. Moses Strong, Geol. of Wis. 4: 1.

numerous ravines, the larger ones called coulés (Cooley) or valleys, the ridges rising from three hundred to five hundred feet above the flood plains of the Mississippi. Naturally the soil is a clay derived from the Oneota limestone. This includes the south half of Richland, Crawford, La Crosse and Trempleau counties.

The third area includes the alluvial flood plain in the valleys of the La Crosse, Black, Kickapoo and Trempleau rivers. The material is of glacial origin, except parts of the Kickapoo and La Crosse rivers.

The principal streams of northeastern Iowa are the Upper Iowa, Yellow and Turkey rivers. At the mouth of the Upper Iowa a large alluvial bottom has formed. It is similar to that of the Root River. A very good idea of the topography may be obtained from Prof. Calvin's account.¹

At Postville the elevation is 1200 feet above the sea level. Postville is situated upon the high land south of the Yellow River and Prof. Calvin is responsible for the statement that at the crest between the Oneota River and Village Creek the land is not only higher than any other in the county, but, beyond that fact, it contains the highest land, at corresponding distances from the Mississippi River, between St. Paul and the Gulf of Mexico. In its general topography this region is similar to that found in Vernon county in the vicinity of Viroqua and Coon Prairie.

"In Allamakee county there is no mantle of drift and there are no indications of invasion by glaciers. The topographic characters imposed by long-continued action of solution and mechanical erosion have never been obscured or modified in any essential or fundamental degree. The surface, therefore, is gashed and furrowed in every direction by an intricate system of ramifying erosion channels. Some small areas in the southwestern part of the county are comparatively level. Ludlow and Union Prairie townships present more of the unusual features of Iowa topography than any other portions of the county. Elsewhere throughout the county topographic forms are bold. Rounded, steep-sided ridges, with gorges and ravines sharply angled at the bottom, prevail except in or near the valleys of the main drainage streams."

1. Ia. Geol. Surv. 4: 2.

CENTRAL IOWA.

For central Iowa two areas will be considered: parts of Hardin and Marshall counties along the Iowa River, and Boone and Story counties along the Skunk and Des Moines rivers.

Hardin and Marshall Counties.—The drift sheets have influenced the general topography of the region in a marked way. Dr. Beyer¹ divides Hardin county into three topographical provinces.



FIG. 3. Sandstone formation in Hardin County. White Pine and Cherry and White Birch in foreground. Photograph by Charlotte M. King.

The first is the loess Kansan type which comprises about one-sixth the superficial area of the county. This area is perfectly drained and includes part of the townships of Providence and Union in the southeastern part. The second province is the Iowan drift plains and comprises the south half of Aetna and the northeast half of Clay township. This is a portion of the great Iowan drift plain which extends from Minnesota across the state through

1. Ia. Geol. Surv. 10: 247.

Worth, Cerro Gordo and Franklin counties. Here the streams have done little cutting. The third province is the area covered by the Wisconsin drift sheet and covers more than four-fifths of the county. The eastern margin is marked by the Altamont moraine.

The chief drainage areas under consideration are Pine and Elk creeks, which lie in the Kansan drift. The Iowa River, which flows through the county in a southeasterly direction, entering the county in Alden township, cutting through the Kinderhook series at Iowa Falls, forms a gorge at Iowa Falls with a height of eighty feet. Between Steamboat Rock and Eldora, at several points, ferruginous sandstone faces the river. In the Iowan drift in Clay township the hills are thickly covered with timber and with small alluvial areas. Below Eldora the alluvial areas increase in size, forming a wider flood plain of the river.

Marshall County.—The whole county is covered by drift, but there are three distinctive areas occupied by the Wisconsin, Iowa and Kansan drift sheets which Dr. Beyer¹ designates as the drift, drift plain and drift loess types. In the western part of the county are many sloughs and "kettle holes." The northeastern part of the county is a slightly rolling plain, with sloughs. The drift loess type contains many small streams and numerous hills. Near the Iowa River, extending in a southerly direction, a few miles south of Albion is a sand-bar that traverses the county, extending southwestward. On the east side of the river is an eminence known as Mormon Ridge, which is heavily covered with timber. The principal streams are the Iowa River, Timber Creek and Minerva and Honey creeks.

Story County.—The surface of the county is gently rolling and, as Dr. Beyer says,² "it is the typical saucer topography so characteristic of the younger drift sheet." Several prominent moraines occur in the county, the Gary, which enters the county from Boone in Lafayette county to Lincoln township. The Altamont moraine touches the county in its eastern part from Sherman to Collins townships. This marks the western boundry of this

1. Ia. Geol. Surv. 7: 203.

2. Ia. Geol. Surv. 9: 439.

moraine. Dr. Beyer gives the altitude of the Altamont moraine near Collins as 1022 feet. The Gary moraine near Summit has an altitude of 1075 feet. The principal streams are Skunk River and Squaw and Indian creeks. According to Dr. Beyer it seems highly probable that the headwaters of the present Des Moines found their way to the Mississippi through the Skunk.

Boone County.—The topography of Boone county has the character of a drift plain. It is flat, except near the streams. The Des Moines, which is the principal river, enters the county in Pilot Mound township and flows in a southerly direction, dividing



FIG. 4. Story County. Wooded area along Squaw Creek. *Tilia americana* and *Ulmus fulva*. Photograph by C. M. King.

the county into two parts. The Des Moines valley is narrow, with numerous small tributaries, also narrow, often with gorges. The most important of these are found in the vicinity of Moin-gona, commonly called the Ledges.

The streams are Bear, Pease, Eversole, Caton, Elk and Bluff creeks. The terraces along the Des Moines River, and other

streams, show the recent development of these streams. Squaw Creek, a tributary of Skunk River, drains the northeastern part of the county.

NORTH CENTRAL IOWA.

The bogs are developed altogether in the glacial area.¹ The general landscape is flat and there are very few valleys except for a few of the larger streams. The hills are low and rounded, being especially developed in the northern part of the area, as in Cerro Gordo and Worth counties and the counties westward. Between these hills, especially in the northern area, are small basins. Dr.



FIG. 5. Ledges, Boone County, Iowa. The dry sandstone exposures, Red, White, and Chestnut Oaks, and Quaking Asp. *Carpinus* and *Ostrya* in timbered areas. Photograph by J. I. Caughey.

Bain says "the low swells contain few sharp contours and are not pronounced enough to deserve the name of hills. They have little individuality and are not arranged according to any order or system. Between them lie ill-defined basins occupied usually by shallow ponds, swamps or swale-areas of slough or shallow water. There are very many basins without outlets, and the whole is clearly a region of immature drainage. At many points springs and shallow artesian wells attest the superabundance of water. . . . The numerous lakes and ponds, the undrained sloughs, the peat bogs, the narrow river valleys, the incomplete drainage, the undissected upland between the rivers, some of which flow 200

1. Ia. Geol. Surv. 6: 431.

feet below the general plain, and many other features all point to one conclusion—that the topography is extremely young and that it was formed by glacial agencies.”

The region has a number of important streams, the Cedar, with its several branches, rising in Cerro Gordo, Worth and Mitchell counties, the Iowa River in Hancock, one branch of the Des Moines in Emmet county and the other in southern Minnesota. The source of these streams is in several lakes. West of the Des Moines basin the rivers flow into the Missouri. Throughout the entire region there are numerous moranic gravel hills, bogs and marshes. The flood plains of the streams are generally narrow, and the large marshes in Wright county and north are flat. This indicates an ancient lake of considerable size. Similar flat expanses occur in Palo Alto, Kossuth and Humboldt counties.

GEOLOGY.

WESTERN WISCONSIN, SOUTHEASTERN MINNESOTA AND NORTHEASTERN IOWA.

The region here considered lies in the driftless area and so has not been modified by glacial action. The broad valley of the Trempleau River is apparently the boundry below which the glacial deposits were not formed. Opposite La Crosse in Houston county, Minnesota, and along the bluffs east of La Crosse and near the mouth of Mormon Cooley Creek, are small deposits of silicious sand, some clay and small gravel. The rounded pebbles are small and consist of quartz, granite, trap and other archæan rocks. These banks are usually covered with sandy humus. Strong holds that this material was brought down by the Mississippi River from the north.¹

The greater part of the area in Wisconsin and Minnesota bordering on the Mississippi River consists of the St. Croix sandstone. This formation occurs in valleys frequently forming sandy prairies.

¹ For a discussion of the formation see Moses A. Strong, *Geol. of Wis.* 4: 1-98.

W J McGee, *The Pleistocene History of Northeastern Iowa*, U. S. Geol. Surv. 11: 190.

Samuel Calvin. *Ia. Geol. Surv.* 4: 42.

Chamberlain and Salisbury. *Rept. U. S. Geol. Surv.* 6: 286.

The strata in the vicinity of La Crosse and Trempleau attain an elevation of 470 feet. Farther northward the elevation diminishes, becoming the surface rock.

This material is made up of a yellow stratified sandstone, green sandstone and shale, hard, compact yellow sandstone, a heavy-bedded, regularly stratified, hard, white sandstone, and a yellow sandstone. These different layers support a somewhat varied flora, depending upon the slope and the amount of soil covering the rock. In some sections the sandstone is often very ferru-



FIG. 6. Kettle-hole in Marshall County, Iowa. *Typha latifolia*, *Iris versicolor*, and *Phragmites* are conspicuous plants. Photograph by Dr. S. W. Beyer.

ginous. The iron found here is a surface deposit derived from the upper ferruginous bed. It is not rich in fossils. The richest fields are found in the southern part of Trempleau and northern part of La Crosse counties. The St. Croix sandstone is exposed in numerous places in Allamakee county, Iowa, according to Prof. Calvin.¹ At Gabbet's Point it rises 300 feet above the level of the river. Towards the head of the Oneota River it is only a few feet

1. Ia. Geol. Surv. 4: 55.

above the channel. At New Albin, near the Iowa-Minnesota line, it is given at 320 feet.

The lower magnesium limestone of Chamberlain or the Oneota is the surface rock of the higher ridges about the heads of the small streams and valleys. This limestone covers all of the higher hills along the Mississippi. On one of the highest bluffs along the Mississippi the heavy-bedded limestone is 90 feet thick—thick magnesium layers alternating with sandstone 50 feet, then bedded yellow shales alternating with white and yellow sandstone. The Oneota limestone covers the St. Croix. Calvin¹ says "The Oneota limestone is one of the most conspicuous and at the same time one of the most important of the geological formations in Allamakee county. It lies directly and conformably upon the St. Croix sandstone, the transition from one formation to the other being made through some fifteen or twenty feet of calciferous sandstone." There are few exposures of Galena limestone on the ridges between the Little Kickapoo and the Mississippi rivers.

The St. Peter sandstone occurs in the shape of mounds and cliffs. In the area under consideration it occurs in Vernon, Mouree, and Buffalo counties. It is the surface rocks in part of Vernon county near Coon Prairie on the ridge dividing the Kickapoo and the Mississippi rivers. These ridges are about a mile and half wide, extending in varying widths and broken mounds to Viroqua. Isolated areas occur in Monroe county on the ridge that divides the Kickapoo from the La Crosse River. In the southern part of Buffalo county there are small exposures between Eagle Creek and Trempleau River. The vegetation of the Wisconsin and southeastern Minnesota region is, therefore, largely influenced by the St. Croix and lower magnesium or the Oneota limestone. The St. Croix sandstone and Galena limestone do not show any marked deviation of plants found on the St. Croix sandstone and the lower magnesium limestone.

The St. Peter sandstone in Allamakee county as limited by Calvin² is as follows: "Limiting the term in accordance with its original application, the St. Peter sandstone of Allamakee county embraces a body of but slightly coherent arenaceous deposits

1. *lc.* 61.

2. *lc.* 68.

having an average thickness of about eighty feet, and lying between the fairly well defined summit of the Oneota and the very definitely marked bed of shale that is found everywhere throughout the county at the base of the Trenton."

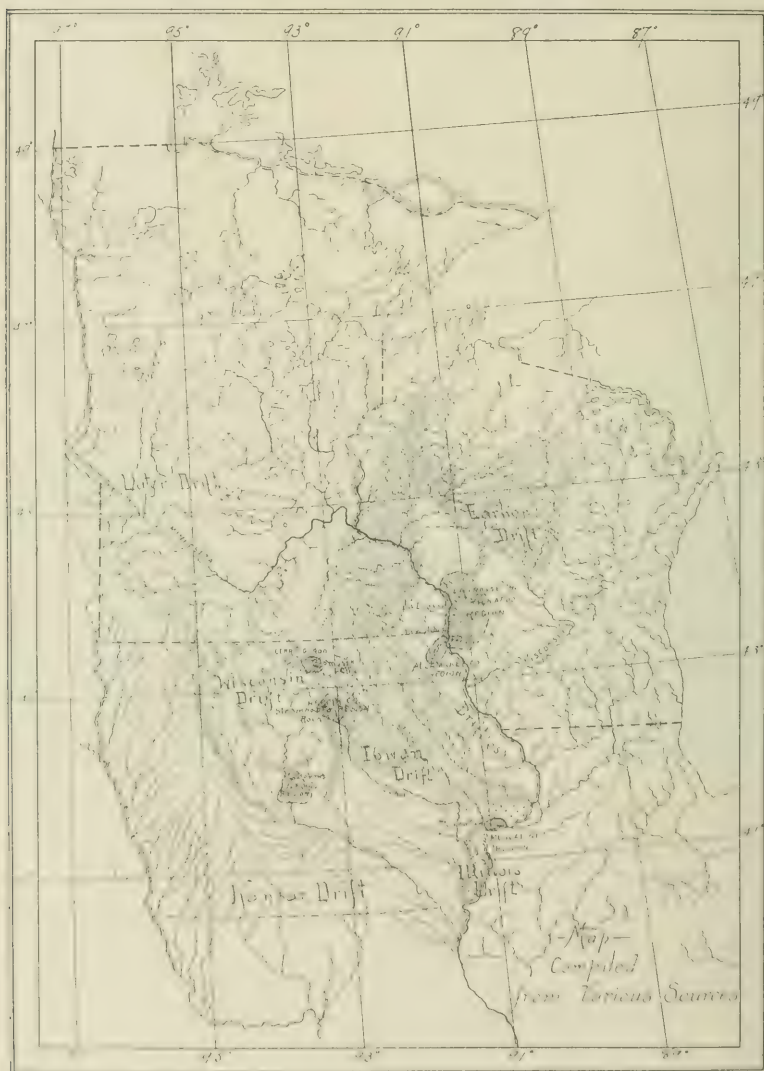


Fig. 7. Geological map showing various drift areas. Map compiled from various sources by Charlotte M. King.

CENTRAL IOWA.

Hardin County.—Dr. S. W. Beyer says,¹ "Geologically the county is of especial interest because it is one of the border counties of the productive coal measures, and its surface has been modified by at least three ice invasions." There are two series to the carboniferous system in the county; the first is essentially limestone, which Dr. Beyer refers to the Mississippi series, the second comprises a ferruginous sandstone and shale and is referred to the Des Moines. I shall deal with the flora of the carboniferous sandstone only. Dr. Beyer describes this sandstone as follows:² "The beds consist of an upper heavy-bedded ferruginous sandstone which often presents conglomerate to concretionary facies and is cross-bedded throughout; and lower shales which carry some coal and often contain highly calcareous, fossiliferous ledges." These sandstone ledges extend along Pine Creek and some of the smaller streams that are tributary to the Iowa River. These beds reach their greatest thickness about two miles north of Eldora where they are about eighty feet thick. The Wisconsin, Iowan and Kansan drift sheets occur in Hardin county on the Kansan drift. Dr. Beyer³ says "The Kansan is known to cover the entire county, but is everywhere more or less obscured by later deposits." The drift sheet along the Iowa River between Steamboat Rock and Eldora is the Kansan, overlaid with a loess deposit. The Iowan drift is developed in eastern Aetna and along Clay township. "The most marked characteristics of the Iowan in Hardin⁴ county, as elsewhere, are its almost monotonously level surface and its train of giant boulders." The Wisconsin drift covers the western two-thirds of the county. The marginal belt of this is from two to five miles wide, according to Dr. Beyer, and extends "through Marshall, Story, and Polk counties to Capitol Hill, Des Moines, and with the moraine of Cerro Gordo and Worth counties is known as the Altamont moraine." Dr. Beyer,⁵ in describing the Wisconsin, says, "As in Story county, certain more or less broken

1. Ia. Geol. Surv. 10: 245.

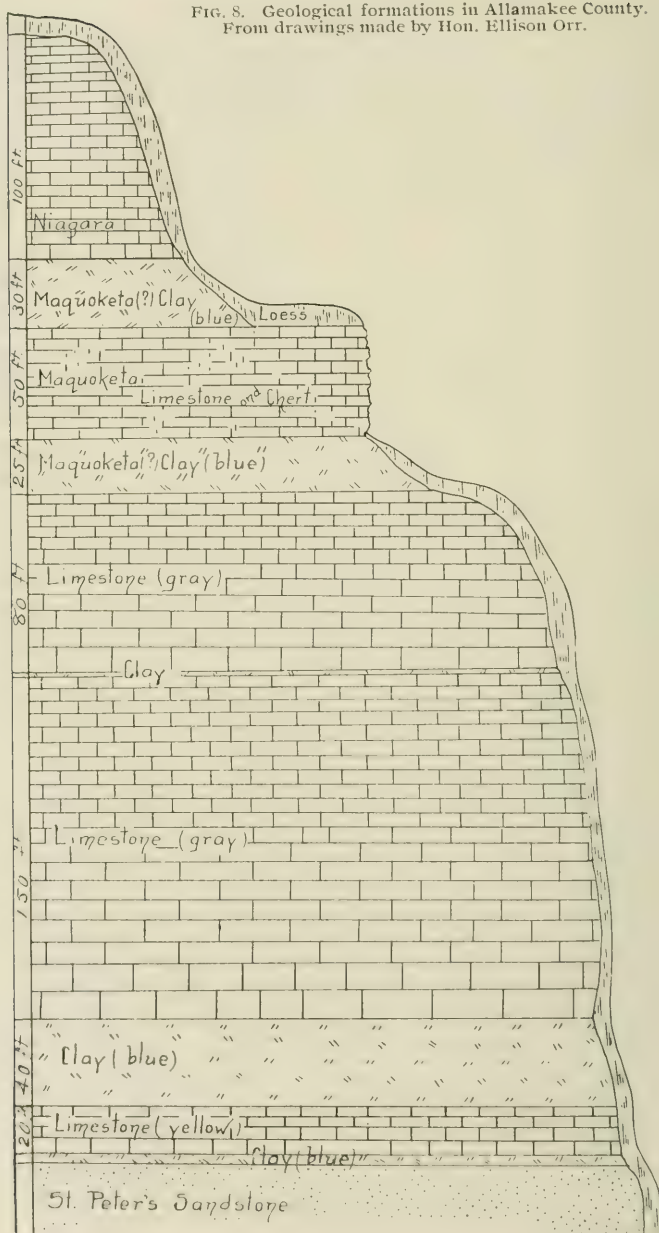
2. lc. 271.

3. lc. 279.

4. lc. 280.

5. lc. 283.

FIG. 8. Geological formations in Allamakee County.
From drawings made by Hon. Ellison Orr.



chains of ridges and knobs concentrically arranged may be noted within the area outlined by the Altamont. These concentric chains indicate halts in the retreat of the ice lobe and have been designated recessional moraines by the leading authorities on glacialogy. The general surface or ground moraine of the Wisconsin has undergone very little modification since the retreat of the ice."

Boone County Geology.—In Boone county the geological formations have been referred to by Dr. Beyer ¹ in two series, the carboniferous and pleistocene. The lower carboniferous formations occur in this county as well as Story, but are not exposed in Boone county. There is a typical exposure of the St. Louis limestone near the eastern border of the county in Story. Drift material is present everywhere and this varies from 60 to 200 feet in thickness. The Des Moines has cut into this carboniferous formation channel with an average depth of 100 feet, showing exposures of sandstone and shales. Drift material covers the entire county except where it has been removed by the present streams, Dr. Beyer giving the thickness at Zenorsville from 60 to 120 feet, at Boone 200 feet. The county is underlain by two drift sheets, the Kansan, which is only exposed at a few points. Boone county lies wholly within the Wisconsin drift sheet and wholly within the outer loup of the terminal moraine and is bounded by the Altamont moraine. In the northern part of the county there is an ancient moraine, the Garry.²

The Cerro Gordo and Worth County Bogs.—It is convenient to consider these bogs in connection with the geology of Boone county as these bogs occur in the Wisconsin drift area. The region here considered is not far from Lime Creek in Cerro Gordo county. It rises in Winnebago county, flows northeasterly across the northwestern part of the county following the morainic belt, in Worth county flowing eastward. Then leaving the moraine, it flows southeasterly over the Iowan drift. The region in Worth and Cerro Gordo counties included in the Altamont moraine consists of numerous "knob-like hills and undrained marshes arranged in the most lawless manner," as so

1. Ia. Geol. Surv., 5: 184.

2. Ia. Geol. Surv., 5: 203.

well described by Prof. Calvin.¹ "The hills are simply knobs of drift that were irregularly heaped up along the margins of the Wisconsin ice. Their height above the tortuous, marshy valleys that wind in and out and branch and rebranch without definable system so as to practically surround each individual knob, varies from forty to seventy or eighty feet." Kettle holes are numerous. Calvin describes these as follows: "They are abruptly depressed below the surrounding level, but they may be found in all situations from the low, ill-drained ground between the hills to the tops of the highest eminences." In place of these kettle holes peat bogs have taken the place with their decaying plants and the remnants of a boreal flora. The largest of these that I examined occurs in the northwest part of Cerro Gordo and the southwestern part of Worth counties. It covers a considerable area and is an ancient lake bed.

CLIMATOLOGY.

Climatic factors are important in determining the character of the plants found in any given locality. Not only the temperature of the air, the precipitation, the humidity, but the temperature of the soil. Prof. Ganong² in an admirable paper on the vegetation of the Bay of Fundy, "Salt and Dried Marshes," takes account of the climatic factors. Schimper, in his great work "*Pflanzengeographie auf Physiologischer Grundlage*," recognizes temperature, light and air as important factors. Nicholas Whitford,³ in his paper, regards the climatic factors as important in connection with the development of the forest. This subject many years ago was discussed admirably by Dr. Gray in a paper on Forest Geography.⁴ The subject is also discussed by Transeau, "On the Geographic Distribution and Ecological Relations of the Bog Plant Societies of North America."⁵

Clements and Pound, in their *Phytogeography of Nebraska*,⁶ discuss the climatic factors. The writer, in his paper on "The

1. Ia. Geol. Surv., 7: 133.

2. Bot. Gazette, 36: 161, 280, 303, 429.

3. Bot. Gazette, 31: 290.

4. Am. Jour. Sci. and Arts, 16: 85. 1878.

5. Bot. Gazette, 36: 401.

6. Pro. Ia. Acad. Sci., 9: 15. Cont. Bot. Dept. I. S. C., 21.

Physiographical and Ecological Flora of Western Iowa," has shown that climatic conditions are important in considering the peculiarities of the loess flora of western Iowa. Finally, there is a full discussion of the climate and the flora of Mt. Katadin by

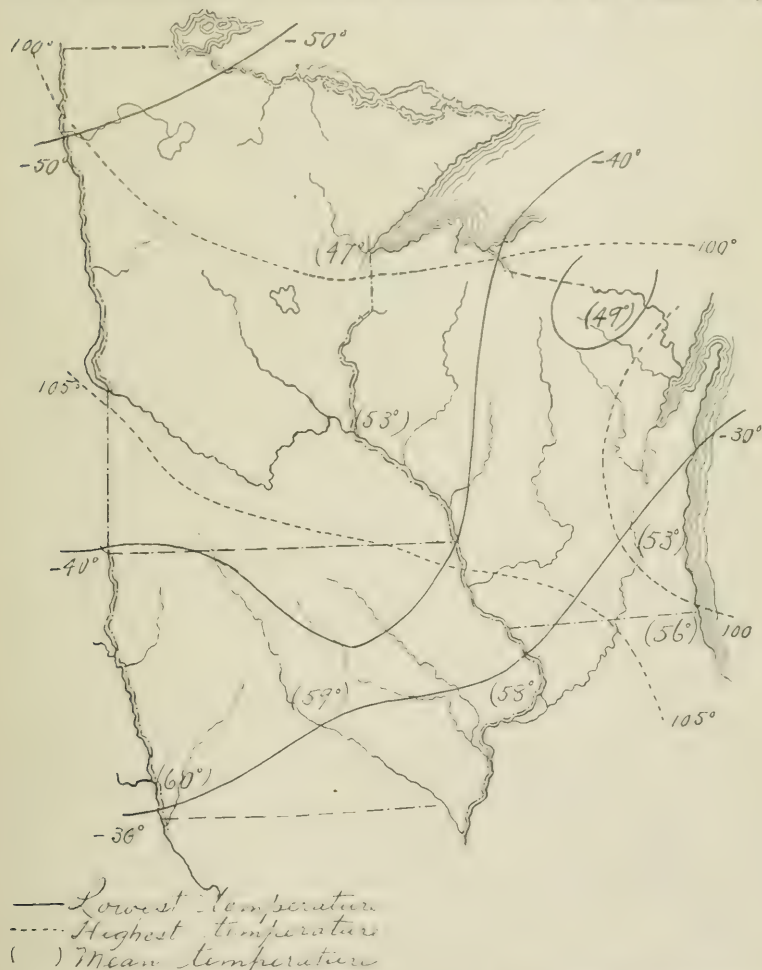


Fig. 7. Map showing minimum and mean temperature for Wisconsin, Minnesota and Iowa. Compiled from various sources by Charlotte M. King.

L. R. Harvey.¹ The subject is also discussed by Coville and MacDougal in a paper dealing with desert conditions of Arizona

1. The University of Maine Studies, 5.

in which they call attention to the great importance of climatic factors.¹

The velocity of the wind seriously affects the transpiration of water from plants.² This is more marked in central Iowa than in western Wisconsin. It is certainly very marked in western

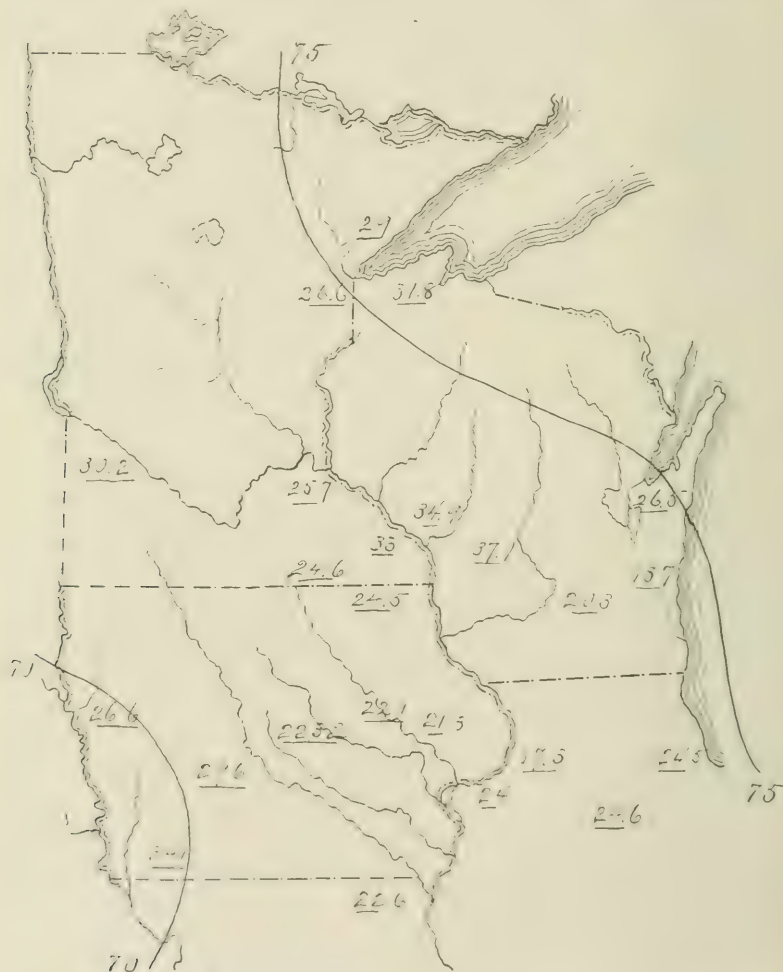


FIG. 10. Map showing normal annual humidity and precipitation for the year 1901; the lines indicate the normal annual humidity, and the figures the precipitation for 1901, a dry year. Compiled from various sources by Charlotte M. King.

1. Desert Laboratory of the Carnegie Institution, 6.
2. Contr. Bot. Dept. I. S. C., 21. Pro. Iowa Acad. Sci., 152.

Iowa, where many of the plants occurring on the loess soil are protected by their thick leaves and pubescence.

For the sake of convenience we shall discuss the subject of climatology under the heads of (1) Precipitation and Temperature of the Different Regions and (2) the Soil Temperatures and (3) Phenology.

Precipitation and Temperature. The time of precipitation and a high mean temperature during the growing period are important in determining the success of an agricultural crop. The same factors apply to many native plants which develop but slowly during the early spring months but attain their best growth when the maximum heat is greater. These plants require long periods of development, as in the Asters, Goldenrods and Thistles. On the other hand, the vernal plants develop at a time when the maximum temperature is much lower, as the Hepatica, Dicentra and Symphoricarpus. Dr. Samuel Weidman³ gives the precipitation for western Wisconsin for the months of June, July and August from ten to twelve and a half inches; mean temperature for July, 70°; the May mean temperature, 56°; precipitation for March, April and May, 6.5-9 inches; mean temperature for September, 61°; precipitation for September, October and November, 8.5-9 inches; the mean precipitation for December, January and February, 3.5-5 inches; mean temperature for January, 15°.

CLIMATOLOGY AT SEVERAL DIFFERENT STATIONS IN THE STATE OF IOWA.

For the purpose of presenting the more important points the following tables are given, showing the climatology for these points: Lansing in northeastern Iowa, Ogden in central Iowa, Muscatine in southeastern Iowa, and an annual meteorological summary for La Crosse, Wisconsin.

3. Wis. Geol. Surv., and Nat. Hist. Surv., 11: 491.

CLIMATOLOGY OF LANSING, IOWA. MEAN TEMPERATURE (DEGREES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1895.....						70.5	72.4	71.0	57.9	47.4	32.0	28.2	
1897.....	17.3	25.2	30.6	48.8	57.9	67.6	75.0	67.8	68.7	57.0	31.2	18.2	47.2
1898.....	23.4	23.3	37.6	47.0	61.3	71.0	72.6	70.0	65.2	48.2	34.0	17.6	47.6
1899.....	18.5	12.2	23.7	50.2	60.3	69.5	73.2	71.9	61.9	57.0	41.2	21.8	47.0
1900.....	21.7	14.9	29.6	51.8	63.4	69.2	72.3	77.6	65.0	58.8	32.6	26.8	48.9
1901.....	22.6	15.8	33.0	51.4	61.5	71.8	73.0	68.6	60.1	52.8	40.9	20.4	
1902.....			48.4	48.4	63.0	65.6	73.0	68.6	60.1	52.8	40.9	20.4	
Average.....	21.3	18.3	30.9	49.6	61.2	69.3	73.1	71.1	63.1	53.5	35.8	22.1	47.7

LANSING, IOWA. MEAN PRECIPITATION (INCHES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1896.....						4.97	1.64	3.07	4.04	2.45	3.20	0.45	
1897.....	2.82	0.94	1.70	2.24	0.94	6.53	2.65	1.40	3.03	0.26	0.81	1.22	24.55
1898.....	0.85	1.70	2.37	3.03	2.38	3.00	3.12	2.37	2.64	5.20	1.93	0.27	28.86
1899.....	0.53	1.77	2.68	4.12	3.87	6.01	1.11	5.00	1.57	1.27	1.75	2.65	32.23
1900.....	1.05	1.14	1.69	2.84	4.35	2.03	5.28	3.02	3.55	4.62	1.92	0.37	31.86
1901.....	0.66	1.08	3.73	1.04	2.97	2.63	6.87	3.18	3.00	1.76	1.75	2.12	
1902.....			1.08	1.08	11.36	3.52	6.87	3.18	3.00	1.76	1.75	2.12	
Average.....	1.18	1.33	2.43	2.39	4.31	4.10	3.49	3.00	2.77	2.59	1.89	1.18	29.40

CLIMATOLOGY OF OGDEN. MEAN TEMPERATURE (DEGREES).

YEAR.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1894.....	14.	17.8	35.	54.	61.	69.	81.8	77.1	66.	51.9	31.1	29.3	47.2
1895.....	23.9	28.8	31.2	51.4	64.8	70.	70.	73.	68.	47.	35.	25.	47.2
1896.....	19.	25.	33.	48.	59.	69.	73.	72.3	58.6	48.2	29.5	31.6	48.9
1897.....	23.	23.	37.	49.	59.	71.	73.	69.	72.	57.	35.	17.	48.2
1898.....	20.5	13.	24.4	48.2	59.6	70.	72.0	74.1	63.1	58.8	32.	17.	47.4
1899.....	26.2	13.9	31.7	53.4	63.8	68.9	73.3	75.4	64.6	60.2	32.6	24.5	49.1
1900.....	22.5	17.	33.6	49.4	60.2	70.7	82.2	73.2	65.0	53.5	35.2	21.2	48.5
1901.....	23.1	17.6	30.1	48.8	61.0	66.1	73.1	70.2	60.7	55.0	43.3	23.3	48.8
Average.....	21.5	19.4	33.2	50.5	61.4	69.7	74.9	73.0	64.7	53.4	35.2	23.4	48.2

OGDEN—PRECIPITATION (INCHES).

YEAR.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1894.....	.32	.42	.54	4.13	3.20	5.39	.01	2.28	2.44	3.82	.26	.98	28.46
1895.....	.21	.52	1.00	4.89	9.66	1.70	3.41	4.61	2.75	.78	1.74	1.00	28.46
1896.....	1.18	.54	1.64	5.24	1.75	1.91	2.13	2.69	3.82	2.95	1.70	.47	37.87
1897.....	9.2	1.01	2.68	1.46	4.73	5.88	1.69	3.64	3.08	1.32	.29	1.54	24.26
1898.....	.11	.38	1.36	1.62	7.80	7.21	2.17	2.87	3.91	3.91	1.27	.33	30.06
1899.....	.31	1.00	2.00	3.40	4.82	6.30	2.17	3.71	1.25	2.01	1.16	1.65	30.43
1900.....	.55	.60	1.61	2.72	4.82	2.76	8.03	8.34	6.86	3.17	.66	.16	45.32
1901.....	1.08	.15	1.87	1.23	6.61	7.85	8.87	7.01	6.87	3.31	.87	1.30	25.95
1902.....	.59	.59	1.52	2.95	5.16	4.88	4.12	4.06	3.25	2.66	2.02	1.63	44.27
Average.....	.59	.59	1.52	2.95	5.16	4.88	4.12	4.06	3.80	2.66	1.11	1.01	32.45

CLIMATOLOGY OF MUSCATINE. MEAN TEMPERATURE (DEGREES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1879.....	17.7	23.4	36.4	48.8	63.0	68.7	75.3	70.7	58.8	58.9	38.2	20.4	48.6
1880.....	35.1	30.0	35.1	48.6	65.1	71.1	75.2	72.8	60.6	48.7	27.4	18.6	49.6
1881.....	11.1	20.1	28.0	42.7	66.6	69.1	75.2	76.7	69.6	54.0	35.1	35.0	43.6
1882.....	23.6	36.4	41.2	49.5	55.0	69.3	69.6	62.7	58.8	58.8	38.7	23.3	49.8
1883.....	9.7	19.0	31.4	50.3	56.2	67.2	69.0	68.3	57.3	47.7	38.0	25.5	45.5
1884.....	10.4	21.1	32.6	46.9	57.8	66.7	69.8	66.9	67.3	55.8	35.8	19.3	45.0
1885.....	11.1	10.4	31.0	47.6	66.9	68.2	76.5	68.8	65.0	47.6	37.1	19.6	45.8
1886.....	14.2	21.2	32.4	50.3	61.2	66.2	75.2	75.4	66.4	65.6	33.7	10.6	42.9
1887.....	18.8	23.4	34.4	50.8	65.0	77.8	78.4	71.8	59.4	48.7	38.4	24.2	47.2
1888.....	9.6	20.9	30.6	50.8	55.0	63.2	74.2	70.7	59.2	48.5	38.5	31.2	46.0
1889.....	25.8	21.4	40.2	50.5	59.6	66.9	73.0	70.0	62.6	49.1	36.7	39.6	49.6
1890.....	26.7	31.5	29.9	52.2	58.8	73.8	75.7	68.9	58.7	50.6	40.8	29.1	49.7
1891.....	21.5	25.9	29.0	52.2	58.6	72.4	67.8	58.5	66.0	51.6	33.8	33.8	47.5
Average.....	20.2	24.7	35.4	46.9	59.8	68.1	71.0	70.5	62.4	50.3	35.1	24.4	47.5

MUSCATINE—PRECIPITATION (INCHES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1879.....	1.20	1.67	2.18	1.81	4.54	3.78	3.40	4.56	2.37	2.85	4.65	1.42	31.83
1880.....	3.02	1.63	3.62	3.02	3.25	7.12	3.84	4.48	2.37	.25	.97	1.31	31.78
1881.....	1.34	3.49	2.58	2.11	2.43	0.38	3.77	1.36	6.59	7.03	2.83	1.75	45.16
1882.....	.84	1.10	2.98	4.00	8.36	8.25	4.55	1.75	1.38	4.29	7.15	2.02	46.17
1883.....	1.66	4.67	.75	5.08	6.19	4.77	4.31	1.45	1.19	6.23	3.45	1.45	41.12
1884.....	1.95	1.40	4.18	2.08	5.57	4.53	3.43	5.77	5.23	6.4	1.57	4.42	45.49
1885.....	2.38	2.21	.25	4.02	4.18	4.81	5.03	7.38	2.88	2.80	.83	2.32	39.44
1886.....	4.21	1.43	4.16	2.02	5.05	2.10	.32	2.62	3.05	4.70	.95	.71	28.50
1887.....	1.88	4.12	1.14	1.26	2.46	2.82	3.9	2.40	3.49	2.24	.98	3.53	28.50
1888.....	1.49	.70	3.10	1.40	6.28	3.82	3.9	7.21	2.00	1.50	1.41	1.31	31.78
1889.....	1.44	1.38	.65	4.28	4.17	5.68	6.69	1.15	3.95	1.04	1.65	1.40	33.47
1890.....	1.96	1.70	3.24	1.11	3.61	6.68	1.88	2.35	2.52	4.24	1.38	1.20	31.87
1891.....	1.75	2.19	3.50	1.11	2.51	4.87	3.29	5.20	1.35	1.49	2.51	2.51	39.22
Average.....	1.81	2.68	2.79	3.41	4.38	4.86	3.91	4.38	3.72	3.04	2.30	2.28	39.22

1. Ann. Rep. Ia. Weather and Crop Service, 1902: 128.

ANNUAL METEOROLOGICAL SUMMARY. LA CROSSE, WIS.

Summaries are for Year Ending December 31, 1901.

Month.	Mo. Temp.	Relative Humidity 8 a.m.	Precipitation. Inches.	Cloudiness	Total Hours Sunshine Recorded. (Local Time.)
January	20.6°	81%	.64	6.1	
February...	13.9	81	.64	4.4	
March.....	31.0	78	2.16	6.8	
April.....	51.5	66	1.17	5.0	
May.....	61.2	73	3.85	4.9	
June.....	70.7	80	5.31	4.5	
July.....	79.2	73	6.49	3.3	
August.....	72.0	84	.93	2.9	
September..	60.4	86	9.84	5.7	
October....	52.6	83	2.70	4.3	
November..	33.4	79	.74	5.5	
December..	18.0	82	.46	6.2	
Average....	4.70	79	34.93	5.0	

U. S. Dept. Agrl., Chief of Weather Bureau, 1901-1902: 102.

ANNUAL METEOROLOGICAL SUMMARY. DAVENPORT, IOWA.

Month.	Mo. Temp.	Relative Humidity 8 a.m.	Precipitation. Inches.	Cloudiness	Total Hours Sunshine Recorded. (Local Time.)
January ..	26.6°	86%	1.10	4.9	
February...	15.7	91	1.59	3.4	
March.....	35.8	83	2.57	6.6	
April.....	50.5	74	.88	5.0	
May.....	61.3	74	1.37	4.5	
June.....	74.2	77	3.02	3.3	
July.....	83.0	65	1.48	1.9	
August.....	74.2	76	.46	3.4	
September..	65.4	82	2.29	4.3	
October....	55.6	84	.45	3.5	
November..	36.8	82	.79	3.6	
December..	22.8	90	1.33	6.5	
Average....	50.2	80	17.33	4.2	

U. S. Dept. Agrl., Report Chief of Weather Bureau, 1901-1903: 80.

ANNUAL METEOROLOGICAL SUMMARY. DES MOINES, IOWA

Month.	Mo. Temp.	Relative Humidity 8 a.m.	Precipitation. (Inches.)	Cloudiness	Total Hours Sunshine Recorded. (Local Time.)
January....	26.3°	84%	1.01	5.2	166.5
February...	20.0	84	1.11	4.8	181.2
March.....	35.8	82	3.02	6.2	181.0
April.....	50.4	78	2.26	5.6	244.0
May.....	61.6	75	1.40	4.8	312.7
June.....	73.4	78	2.41	4.5	329.1
July.....	84.0	68	1.72	3.5	390.1
August.....	75.0	77	.67	4.4	318.9
September..	64.8	83	2.60	5.5	199.9
October....	56.2	81	2.14	4.5	230.0
November..	37.6	80	.40	4.1	212.7
December..	21.9	86	1.03	6.1	144.1
Average....	50.6	80	19.77	4.9	

U. S. Dept. Agrl., Chief of Weather Bureau, 1901-1902: 82.

SOIL TEMPERATURES.

It has long been recognized that the temperature of the soil is an important factor in plant growth, especially in its relation to the development of plants. In a cold soil or stratum plants are necessarily much retarded in their development; in fact, a cold soil produces a much different plant than a warm soil. This is well illustrated in the plants found in the bogs of Worth county and the plants found on the shady limestone rock in Allamakee county. Dr. MacDougal¹, in a paper on soil temperatures and vegetation, discusses the importance of making such observations. These records, however, should be continued.

Temperature records on the soil in wood and field have been kept for some years at this station but, there is no other data except for a few of the published records and a number of additional observations made since. These are inserted here for the purpose of comparing them with records at other places. For records taken at Boone I am indebted to Mr. Wilson and Mr. Morrow. For the records at Ames I am indebted to Mr. Bourne and Mr. Dixon. The records at La Crosse were made by Louis Pammel.

SOIL TEMPERATURE FOR AMES AND LA CROSSE.

LOCALITY.	Soil.	Date.	At a Depth of Six Inches.		
			7 A. M.	12 M.	7 P. M.
La Crosse, Wisconsin.	Sandy	May 6	62	64	68
Ames, Iowa.....	Wis. drift	" 6	36	40	42
La Crosse.....	Sandy	" 7	62	70	72
Ames.....	Wis. drift	" 7	38	44	47
La Crosse.....	Sandy	" 8	58	58	56
Ames.....	Wis. drift	" 8	39	40	41
La Crosse.....	Sandy	" 9	50	58	58
Ames.....	Wis. drift	" 9	39	44	42
La Crosse.....	Sandy	" 10	46	56	63
Ames.....	Wis. drift	" 10	39	44	46
La Crosse.....	Sandy	" 11	54	60	64
Ames.....	Wis. drift	" 11	40	42	47
La Crosse.....	Sandy	" 12	53	53	56
Ames.....	Wis. drift	" 12	42	44	47
La Crosse.....	Sandy	" 13	52	54	54
Ames.....	Wis. drift	" 13	45	49	50
La Crosse.....	Sandy	" 14	48	54	54
Ames.....	Wis. drift	" 14	45	50	52
La Crosse.....	Sandy	" 15	38	54	60
Ames.....	Wis. drift	" 15	46	52	54
Ames.....	Wis. drift	Mar. 29-31	31.6	32.6	33.3

1. U. S. Monthly Weather Review, 1903: 379. Repr. Cont. N. Y. Bot. Garden, 44.

SOIL AND AIR TEMPERATURE OF THE LEDGES.

Locality.	Character of Soil.	Date, May 15, 1904.	Temp. of Air.	Temp. of Soil, 1 in., 6 in.	Exposure.
Ledges, Boone Co.	Sandy.	2:00 P. M.	62°	54	Temp. on rock 71°. West slope.*
"	Sandy loam.	2:00 P. M.	57	59	Knoll 60 feet high, exposed to sun.
"	Loamy.	2:00 P. M.	61	56	Bare ground.
"	Loamy.	2:00 P. M.		62	Covered with grass.
"	Loamy.	2:00 P. M.		52	Bare ground.
"	Black sandy loam.	2:00 P. M.	62	50	Covered with grass.
"	Sandy loam.	2:30 P. M.	72	49	Soil covered with dead leaves.
"	Sandy loam.	2:30 P. M.	62	60	Exposed south side. Eighty feet high.†
"	Sandy creek bottom.	2:30 P. M.	62	55	West slope.
"	Sandy creek bottom.	2:30 P. M.	62	49	Covered with grass.
"	Alluvial.	3:00 P. M.	61	55	Des Moines Riv. and bottom. Cult. 1903.
"	Alluvial.	3:00 P. M.	61	60	Des Moines River. Plowed, 1904.
"	Alluvial.	3:00 P. M.	64	71	

* Ledge 20 feet high.

† Plants 5-6 days in advance of shady slopes.

In the soil temperatures taken a few years ago at Ames it was found that there is a great deal of fluctuation even in the summer at the depth of from one inch to a foot, but at three feet there is little variation. The amount of covering also influences the temperature of the soil. In 1892 soil temperatures, as well as the temperature in oats and a patch of bachelor's button, were kept during the months of May, June and July.¹ The temperature in the oat field or in the bachelor's button were uniformly lower than the temperature of the air. The table on the following page will show the difference.

1. Bull. Ia. Agr. Exp. Sta., 18: 488.

METEOROLOGICAL RECORD, AMES, IOWA.

DATE.	Mean Temp. of the Air.	Precipitation.	DATE.	Mean Temp. of the Air.	Precipitation.
May 13.....	50.6	2.86	June 29.....	67.6	
" 24.....	64.3		" 30.....	61.3	
" 25.....	62.		July 1.....	66.	
" 30.....	67.		" 2.....	71.7	
" 31.....	52.		" 14.....	78.8	
June 1.....	49.3	3.74	" 15.....	71.8	
" 2.....	55.6		" 30.....	71.7	
" 14.....	71.3		" 31.....	72.	
" 15.....	77				

RADIATION THERMOMETER IN OATS.

DATE.	Minimum.	9 A. M.	12 M.	5 P. M.	Mean.
May 13.....	28		62	56	48.6
" 24.....	47	74	65	73	64.7
" 25.....	41	76	78	69	66
" 30.....	46	65	78	70	64.7
" 31.....	48	50	49	50	49.2
June 1.....	44		47	44	44.6
" 2.....	44	66	61	78	62.2
" 14.....	51	65	71	66	63.2
" 15.....	51	70	75.5	79	68.8
" 29.....	49.5	62	73	69	64.3
" 30.....	45	60	70	64	62.2
July 1.....	41		66	62	56.3
" 2.....	54	66	63	67	62.5
" 14.....	57	73	82	79	72.7
" 16.....	50	64	68	75.5	62.1
" 30.....	46	65	73	65	62.2
" 31.....	52	68	74	63	64.

PHENOLOGICAL DATA.

The time of blooming of a good many plants has been kept at Ames for a number of years.¹ Notes on a few plants are inserted here. These data have been collected by Miss Charlotte M. King.

PHENOLOGICAL TABLE.

	TIME OF BLOOMING.				
	1896	1901	1902	1903	1904
<i>Acer nigrum</i>	4-26	4-29	4-26		5-15
<i>Acer saccharinum</i>		3-23	4-11	3-17	4-2
<i>Æsculus glabra</i>		5-3	5-11	5-7	
<i>Aster lævis</i>			5-5		
<i>Aster novæ-angliæ</i>			8-20		
<i>Astragalus canadensis</i>			8-20	7-10	
<i>Cratægus mollis</i>		5-3	7-18	5-13	

1. Report Iowa State Hort. Soc., 36: 114; 37: 131; 38: 113.

	TIME OF BLOOMING.				
	1896	1901	1902	1903	1904
<i>Cratægus punctata</i>					6-2
<i>Gentiana andrewsii</i>				9-15	
<i>Gentiana quinqueflora</i>				9-10	
<i>Gerardia tenuifolia</i>			8-20		
<i>Geranium maculatum</i> ..		5-9	5-11	5-12	5-13
<i>Helianthus grosse-seratus</i>					7-28
<i>Heliopsis scabra</i>			6-5		
<i>Isopyrum biternatum</i>		4-23	4-19	4-17	4-20
<i>Lilium canadense</i>				7-10	
<i>Lilium philadelphicum</i> ...			6-19	6-23	6-16
<i>Lobelia cardinalis</i>				8-18	
<i>Lobelia syphilitica</i>				8-28	
<i>Melilotus alba</i>				6-28	
<i>Monarda fistulosa</i>					7-19
<i>Negundo aceroides</i>	4-10		3-19		4-27
<i>Phlox divaricata</i>			4-28	4-23	5-4
<i>Phlox pilosa</i>			5-9	5-22	6-5
<i>Physocarpus opulifolius</i> ..		6-1		5-28	6-10
<i>Podophyllum peltatum</i> ...		5-19	5-4		5-15
<i>Prunus americana</i>	4-19	4-24	4-27	4-17	5-8
<i>Prunus virginiana</i>	5-8	5-7			5-12
<i>Pycnanthemum lanceol'm.</i>					7-18
<i>Pyrus ioensis</i>	5-2	5-6	5-9		5-8
<i>Pyrus prunifolia</i>		4-27		4-29	
<i>Ranunculus abortivus</i> ...			4-26	4-16	5-3
<i>Ranunculus septentrion's.</i>				4-18	5-4
<i>Solidago latifolia</i>				8-11	
<i>Solidago missouriensis</i> ...					7-20
<i>Solidago rigida</i>		8-20	8-28	8-8	
<i>Taraxacum officinale</i>		3-24		4-7	4-6
<i>Trillium nivale</i>	4-17			3-17	4-3
<i>Verbena hastata</i>					7-22
<i>Veronica virginica</i>				7-10	
<i>Vicia americana</i>			5-31	5-19	5-24
<i>Vitis riparia</i>	5-1	5-18	5-24	6-1	6-10

TIME OF BLOOMING OF PLANTS FOR 1904.

	LOCALITY.			
	Lansing.	Ames.	Elkader.	Davenport.
<i>Anemone thalictroides</i>	5-10	4-22	5-2	4-27
<i>Aquilegia canadensis</i>	5-14	5-13		5-14
<i>Arisæma triphyllum</i>	5-14	5-5	5-27	5-12
<i>Capsella bursa-pastoris</i>	5-9	4-10	4-27	5-2
<i>Claytonia virginica</i>	5-5	4-17	5-3	4-25
<i>Cratægus mollis</i>	5-14	5-6	5-22	5-12
<i>Dicentra cucullaria</i>	4-25	4-17	4-27	4-20
<i>Erythronium albidum</i>	4-30	4-28	5-2	4-27
<i>Geranium maculatum</i>	5-14	5-13	5-14	5-10
<i>Podophyllum peltatum</i>	5-14	5-15	5-22	5-14
<i>Prunus americana</i>	5-5	5-3	5-4	5-7
<i>Ranunculus abortivus</i>	5-7	5-3	5-15	4-30
<i>Ranunculus septentrionalis</i>	5-9	5-4	5-15	
<i>Ribes aureum</i>	5-7	5-5	5-5	5-2
<i>Taraxacum officinale</i>	5-1	4-6	4-27	4-3
<i>Tradescantia virginica</i>	5-25	5-18	6-6	5-30
<i>Uvularia grandiflora</i>	5-6	5-3	5-10	4-27
<i>Viola cucullata</i>	5-1	5-3	5-10	5-7
<i>Viola pubescens</i>	5-7	5-3	5-14	5-7

PHYSICAL AND CHEMICAL PROPERTIES OF SOME
TYPICAL SOILS OF THE REGION.

Physical.—The physical character of the soil influences in a marked degree the kind of native vegetation found in the same. Several reports and papers issued by the Bureau of Soils of the United States Department of Agriculture have discussed some of the problems. The Bureau of Soils¹ has carried on some elaborate field investigations and in some instances the work has been applied to the native vegetation. Some interesting work has been carried on by Means and Holmes.

Kearney has given some attention to the study of soil production, and the growth of plants, in alkaline solutions. The question of alkalies and the growth of special plants has been made a subject of papers by Davie and Loughridge.² There are not many alkali spots in Iowa. Some of the old lake beds in Northern Iowa show alkali which consists chiefly of magnesium car-

1. Field Operations of the Division of Soils. 1902: 333.

Milton Whitney. Field Operations of Division of Soils. 1900. 2: 274.

Milton Whitney. Field Operations of the Bureau of Soils. 1901: 3: 647. 95 pl.-25f-31 maps.

Whitney. Soils in Their Relations to Crop Production. Yearbook U. S. Dept. of Agriculture. 1894: 129.

2. Report U. of California Agri. Exp. Sta., 1895-7. Separate 24.

bonate. This substance forms a white crust on the surface. There is here a poor growth. The *Hordem jubatum* thrives, *Scripus palustris* and *Polygonum Muhlenbergi* make but feeble growth in some old lake beds. *Rumex maritimus*, *Scirpus pungens* and *Triglochin* occur. Our soils are usually so well leached that few of these halophytes grow.

Some of the more important plants found in certain alkali soils of the west, like the *Sporobolus airoides*, *Scirpus maritimus*, *Distichlis apicata*, are not found in Iowa though they occur in Nebraska. It has been found by Davie that the Creosote bush, and the Larrea, the *Sporobolus airoides*, and *Distichlis spicata* are confined to special areas.

The physical problems of the soil have long been studied by Dr. Hilgard¹ and no one is more familiar with these problems than he.

Several interesting contributions have been made by Dr. Hilgard, Profs. Loughridge, Snow and Shaw² especially on the physical problems connected with the soil and crop production. Attention should also be called to the excellent work by Warrington.

Dr. Ganong has applied some of the problems to a province of the Bay of Fundy Salt Marshes in the Provinces of New Brunswick and Nova Scotia. The Bay of Fundy marsh soil, according to Dr. Ganong, contains but a small amount of clay in comparison with silt and fine silt. This soil when exposed to the sun becomes very hard, making it difficult for germinating seeds to push their way through. These conditions do not prevail in any of our soils except locally. There is nearly always enough sand to make the soil capable of good aeration.³

In order to touch our local problems, Dr. J. B. Weems and Mr. C. E. Ellis have kindly made, for the writer, physical examination of some typical virgin soils in Central Iowa and Western Wisconsin. The soils studied here are from widely varying conditions. The first series of analyses are from soils in Boone County, the ledges. The remainder from La Crosse, Wis.

1. U. S. Tenth Census Report. Cotton Production of the U. S.
Various papers in Rep. U. Calif.

2. Lectures on Some of the Physical Properties of Soil. Oxford. 1900.
Many other works, like Storer's, dealing with agriculture and some of its relations to chemistry.

3. Bot Gazette, 36: 280.

MECHANICAL ANALYSIS OF SOILS FROM LEDGES. BOONE, IOWA.

	I. Top of the bluff where <i>Populus grandidentata</i> and <i>Quercus alba</i> grow.	II. Where the Reindeer Lichens, <i>Polytrichum</i> <i>junciperum</i> and <i>Polygala senega</i> grow.	III. From the sandy rock where <i>Polypodium</i> <i>vulgare</i> and <i>Mittella</i> grow. Soil dry.	IV. Bottom soil near river. Contains much allu- vium. Where <i>Elymus</i> <i>virginicus</i> and <i>Leersia virginica</i> grow.
Coarse gravel.....	1.1 %	1.1 %		
Fine gravel.....	4.63	.04	.34%	.40
Coarse sand.....	2.1	.08	1.10	.55
Medium sand.....	3.14	.40	12.10	1.85
Fine sand.....	13.54	7.11	55.82	25.18
Very fine sand.....	38.84	57.81	12.53	42.79
Silt.....	11.70	11.03	5.84	9.61
Fine silt.....	20.89	18.34	8.83	11.80
Clay.....	1.54	1.14	.70	1.05
Moisture.....	.69	.51	.10	1.01
Organic matter.....	3.19	3.55	2.75	5.99
	100.17	100.01	100.11	100.23

The La Crosse soils* are similar to those occurring in northeastern Iowa. They have been selected to show the types of native plants found there. The Tamarack soil originally contained more humus, but by repeated washings has received some sand from tilled soil near by.

MECHANICAL ANALYSES OF LA CROSSE, WISCONSIN, SOILS

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
Coarse gravel.....								
Fine gravel.....	.93	.05	.19	.75	15.11	.24	6.38	3.88
Coarse sand.....	.75	.04	.24	.60	7.78	.26	4.65	1.49
Medium sand.....	1.12	.05	.64	.87	9.49	.46	6.80	2.80
Fine sand.....	5.42	.40	9.41	4.55	27.22	6.52	31.27	11.86
Very fine sand.....	17.68	10.57	49.96	50.99	22.76	38.83	27.82	26.16
Silt.....	23.32	27.20	22.52	22.89	5.25	17.26	7.38	13.75
Fine silt.....	14.98	19.53	11.09	9.39	9.56	25.61	11.02	29.62
Clay.....	.81	1.20	1.87	1.28	.78	1.46	.98	3.19
Moisture.....	5.60	7.01	1.73	1.69	.46	3.09	.77	2.00
Organic matter.....	29.42	33.90	5.34	7.34	1.66	6.38	3.00	5.25
	100.03	99.95	99.99	100.35	100.07	100.11	100.02	100.00

No. 1 is a peaty soil. The following plants are found on this soil: *Saxifraga pennsylvanica*, *Cornus stolonifera*, *Caltha palustris*, *Habenaria psychodes*, *Bromus kalmii*, *Lilium canadense*, *Symphlocarpus feticidus*, *Carex* sp.

*The La Crosse soils were collected by my brother, H. Pammel, and my father, while the soil from the Ledges was collected by Mr. C. E. Ellis, who made the chemical analysis of the soils.

No. 2. An agricultural soil, black sandy humus. *Quercus rubra*, *Q. alba*, *Carya alba*, *Cypripedium pubescens*, *Panicum macrocarpon*, *Bromus ciliatus*, *Phlox divaricata*, *Corylus americana*, *Festuca nutans*, *Cystopteris fragilis*.

No. 3. Yellow clay on agricultural soil, excellent for small grain and tobacco. *Anemone nemorosa*, *Quercus alba*, *Q. tinctoria*, *Ranunculus fascicularis*, *Phlox divaricata*, *Sanguinaria canadensis*, *Comandra umbellata*, *Polygala senega*.

No. 4. Sandy brownish-black. St. Croix sandstone mixed with humus. *Betula papyrifera*, *Physocarpus opulifolius*, *Dodecatheon media*, *Campanula rotundifolia*, *Aquilegia canadensis*, *Melica mutica*, *Pellaea gracilis*, *Woodsia obtusa*, *W. ilvensis*, *Vaccinium pennsylvanicum*.

No. 5. Brownish sand, St. Croix, little humus. *Betula papyrifera*, *B. lenta*, *Quercus tinctoria*, *Pinus strobus*, *Juniperus virginiana*, *Helianthemum canadense*, *Potentilla argentea*, *Woodsia obtusa*, *W. ilvensis* (dry), *Pellaea gracilis*, *Phegopteris dryopteris*, *Vaccinium pennsylvanicum*.

No. 6. Peaty, wet and mucky. Taken from Tamarack marsh with considerable drift material containing sticks, leaves, cones, etc. *Larix americana*, *Cornus stolonifera*, *Cypripedium spectabile*, *Calamagrostis canadensis*, *Potentilla palustris*, *Maiantherum canadense*, *Caltha palustris*, *Nemophantes fascicularis*, *Glyceria arundinacea*, *Saxifraga pennsylvanica*, *Viola blanca*, *V. canina* var. *Muhlenbergii*.

No. 7. Sandy soil. St. Croix sand, much coarse gravel and ancient bed of the Mississippi River. A poor agricultural soil. Contains a small amount of moisture. Crops mature rapidly. Suited for early vegetables. Contains little organic matter. *Talinum teretifolium*, *Helianthemum canadense*, *Tephrosia virginiana*, *Cenchrus tribuloides*, *Prunus pumila*, *Cyperus schweinitzii*, *Eriogonum rhombipetalum*, *Potentilla argentea*, *Oxalis corniculata*, *Hedysarum hirtum*, *Delphinium azureum*.

No. 8. Yellow clay similar to No. 3, supporting a somewhat similar vegetation.

These sandy soils have some points of similarity to the soil from the ledges. They support a somewhat similar vegetation. The soil from the ledges is of a much later geological origin.

Chemical.—Several European investigators have discussed the subject of the chemical conditions of the soil with reference to the poorly developed plant forms in bogs.* Ganong† reports on the chemical analyses from the marsh well of Cornwallis Valley, Nova Scotia. The fertility of the marshes is due to the necessary mineral and organic constituents present to produce good crops being present in an unusually large amount, and are in an immediately available form. He then devotes considerable attention to the sodium chloride in some soils and its relation to the growth of plants.

* Nilsson. *Einiges über die Biologie der Schwedischen Sumpfpflanzen*. Bot.-Cent. 76: 9.

† Ganong. Bot. Gazette. 36: 285.

CHEMICAL ANALYSES OF SOME SOILS.

	Insoluble residue ..	Soluble silica.....	Alumina..... Al_2O_3	Ferric oxide..... Fe_2O_3	Lime..... CaO	Magnesia..... MgO	Sulphur trioxide..... SO_3	Phosphor. pentoxides P_2O_5	Soda..... Na_2O	Potash..... K_2O	Moisture.....	Loss on ignition.....	Total per cent.
No. 1. Top of bluff at Ledges, Boone.....	90.34	.05	2.24	2.16	.57	.39	.11	.13	.36	.26	.69	3.19	100.49
No. 2. Ledges where lichens grow, Boone....	88.17	.02	2.26	3.60	.48	.55	.03	.12	.27	.28	.51	3.55	100.04
No. 3. Top of rock where moss grows, Boone	92.97	.04	.28	3.00	.96	.33	.10	.15	.18	.19	.10	2.71	100.01
No. 4. Bottom soil near D. M. River, Boone.	83.75	.03	2.10	1.72	3.04	1.41	.08	.25	.36	.26	1.01	5.99	100.00
No. 5. Yellow clay, Ledges, Boone.....	84.12	.05	3.16	3.20	.76	.42	.08	.17	.34	.32	2.04	5.21	100.32
No. 1. Peat, La Crosse, Wis.....	58.35	.05	2.41	2.40	1.51	.75	.25	.22	.38	.21	5.35	28.07	99.95
No. 2. La Crosse, Wis.....	48.17	.05	1.99	2.88	4.26	.81	.42	.44	.27	.11	6.65	33.90	99.95
No. 3. Yellow clay, La Crosse, Wis.....	86.14	.03	3.72	3.64	.50	.41	.06	.20	.22	.11	1.74	3.87	100.04
No. 4. La Crosse, Wis.....	82.07	.03	2.97	2.80	.99	.46	.20	.22	.36	.25	1.69	7.39	99.46
No. 5. La Crosse, Wis.....	92.28	.05	1.64	1.84	.69	.32	.20	.22	.35	.19	.42	1.80	100.00
No. 6. Boggy peat, La Crosse, Wis.....	82.52	.01	4.08	2.72	.7	.68	.07	.19	.45	.13	3.05	5.68	100.31
No. 7. La Crosse, Wis.....	88.01	.02	.97	2.24	2.48	1.23	.11	.22	.54	.12	.90	3.17	100.01
No. 1. Earle Buchanan (E. G.).....	70.25	.03	2.73	1.84	4.24	1.16	.34	.20	.37	.24	2.84	15.73	99.99
No. 2. Earle Buchanan (E. G.).....	82.22	.04	3.44	2.08	.62	.44	.14	.39	.35	.12	1.72	8.54	100.10

BACTERIOLOGICAL ANALYSES OF SOILS.

Two recent papers discuss the bacteria found in American soils. In a paper published by Dr. Mayo and A. T. Kinsley of the Kansas Agriculture Experiment Station the number of bacteria found in the sandy loam, in which native buffalo grass was growing, was estimated at 143,000, and the numbers in black loam, in which Alfalfa and Clover were growing was estimated at 21,091,000. A paper by Prof. Frederick D. Chester of Delaware gives the following table to show the relation of numbers of bacteria in the soil to ammonifying and acidifying efficiency:

SOIL.	Total number of bacteria per gram dry soil.	Total amonify- ing efficiency	Total acidify- ing efficiency
Experiment Station Garden.....			
1st analysis.....	3,130,000	13.75	2.22
2nd analysis.....	1,294,000	2.48	1.81
Murray Soil, Viola.....	250,000	2.13	0.69
Killen Soil, Felton.....	540,000	8.90	0.58
Detrich Soil, Chestnut Hill.....	4,040,000	26.68	8.57

It is not my purpose here to consider the copious literature on the subject, nor have we attempted to study the subject of nitrification in connection with the soils under consideration. I am indebted to Mr. E. B. Watson and Mr. H. Ness, two special students in the botanical laboratory, for a brief study of the bacteria of some typical Iowa soils.

SOILS FROM BOONE COUNTY.

LOCALITY.	Bacteria per Gram.	Time of Collec'n.
Sandy loam in forest.....	626,420	April 15, 1904
Average.....	1,038,078	
	832,244	
Sandy loam, Reindeer lichen formation	31,907	April 15, 1904
Average.....	42,485	
	37,196	
Polytrichum formation on moist rock..	3,592,030	April 15, 1904
Average.....	288,950	
	1,950,490	
Sandy bottom.....	2,560,516	April 15, 1904
Average.....	640,124	
	1,600,320	
Clay soil.....	409,024	April 15, 1904
Average.....	531,263	
	470,143	

SOILS OF LA CROSSE, WISCONSIN.

No.	NATURE.	Bacteria per Gram.	Per Cent of Acid Bacteria.	Time of Collecting.
1.	Peat	1,410,000	20	April 29, 1904
2.	Black soil	2,332,000	10	" " "
3.	Clay	2,008,000	25	" " "
4.	Black soil	834,000	25	" " "
5.	Yellow sandy.	375,000	0	" " "

PEATY SOILS OF FRANKLIN COUNTY, IOWA.

No.	NATURE.	Bacteria per Gram.			Time of Collecting,	
1.	From surface.....	2,467,450			March, 1904	
2.	" " "	2,940,000			" "	" "
3.	" " "	3,937,000			" "	" "
4.	" " "	4,725,000			" "	" "
	Average.....	3,517,362				
1.	From inner portion..	27,500	0	28,894	8	Mar., '04
2.	" " "	29,000	1,687	116,052	0	" "
3.	" " "	1,250	5,625,000	492,364	0	" "
4.	" " "	2,500	8,872	746,052	2,140,625	" "
	Average.....	15,312	1,408,889	345,813	535,156	

Average of all plates.....576,300

It will be seen from these results that a very large number of organisms appear in all of the soils, and that a great percentage of the species, especially in La Crosse soils, are acid producing, the largest number of organisms being found in the black, arable soils, while the smallest number of the organisms are present in the sandy loamy soils. They referred some of the species to the following: *Bacillus albus*, which, in addition to the characters given, had the property of reducing nitrates to nitrites; *Bacillus delicatulus*, or perhaps the *B. venenosus liquefaciens*, also reducing nitrates to nitrites. It is believed by Dr. Vaughan that the *B. venenosus* is pathogenic. It has been found in water supplies. These organisms were found in peat. In the black soil the organisms appear to be *Bacillus rubescens* and *B. epidermidis*, both reducing nitrates to nitrites. In the clay soil were found *Bacillus venenosus* and in the black soil *Micrococcus agilis*. The *B. venenosus* only slightly reduced nitrates to nitrites. The *Micrococcus agilis* reduces the nitrates very slowly.

The peat soil from the bogs of Franklin county contained the following organisms: *Micrococcus citreus*, *Bacillus incanus*, *B. albus*, *B. delicatulus*, *B. punctatus*, and *B. venenosus brevis*. All these produced nitrites from nitrates, especially the *B. incanus*.

PLANT FORMATION.

WESTERN WISCONSIN AND NORTHEASTERN IOWA.

Clay Ridge Formation.—The plants of this formation are quite uniform throughout the entire region. Sometimes one or more species of trees may predominate. The flat areas naturally have different species of plants in part than the sunny and shady slopes. Of the trees the most conspicuous on the flat slopes are the oaks (*Quercus alba* and *Q. ruba* and *Q. tinctoria*). The shell bark hickory (*Carya alba*) is widely scattered but never in solid groves. Two poplars are common, (the *Populus tremuloides* and *P. grandidentata*). These species frequently form solid groves. Occasionally the basswood (*Tilia americana*) may be interspersed with the oaks and hickories, but this tree is usually found on the shady, moist slopes where the white and red oak, paper birch, two ironwoods (*Ostrya virginica* and *Carpinus caroliniana*) and pignut (*Carya amara*), two ashes (*Fraxinus sambucifolia* and *F. viridis*) also occur. The common *Pteris aquilina* is abundant everywhere forming a conspicuous feature of the woods wherever the timber has been removed. This fern soon occupies the ground, growing from two to three feet high. In such openings *Potentilla canadensis* and *Fragaria virginiana* are abundant. Formerly in such woods many strawberries were picked for home consumption. The *Apocynum cannabinum*, *Panicum macrocarpon*, *Bromus purgans*, *Calamagrostis canadensis*, *Phlox divaricata*, *Scirponema ciliatum*, *Senecio aureus*, *Helianthus strumosus*, *Triosetum perfoliatum* and *Galium boreale*, *Agrimonia eupatoria*, *Geranium maculatum* occupy similar places.

In the shady woods *Panicum macrocarpon*, *Geranium maculatum*, *Anemonella thalictroides*, *Anemone nemorosa*, *Cypripedium pubescens* occur, the Phlox, Geranium, Panicum and Anemonella in greater abundance than the other species. The moccasin flower is widely scattered but never abundant.

Exposed Limestone Flats.—This formation at La Crosse is nearly 600 feet above the flood plain of the Mississippi. These areas do not cover much ground. In their younger stage they have the aspect of a typical prairie vegetation such as occurs in parts of Iowa. The most typical plant is the *Zygadenus elegans*

and *Ranunculus rhomboideus*. On the limestone rocks there are large prostrate masses of *Juniperus virginiana*. The *Campanula rotundifolia*, *Arabis lyrata*, *Koeleria cristata*, *Aquilegia canadensis* are abundant. The most characteristic plant, however, is the *Zygadenus* which is found only on these flats.

The St. Croix Area.—Immediately below these limestone exposures is a sandy area in many places showing the St. Croix exposures where there has been much weathering. The soil is of a brownish color or it is blackish when it contains much humus. This area is in part treeless, but much of it consists of grassy covered slopes. The remainder is covered with a forest growth. Each of these areas will be considered separately.

Grassy Slopes.—The grassy slopes are made up in large part of grasses of a few species, among these *Bouteloua curtipendula*, *Andropogon scoparius*, and *Koeleria cristata*. Among the more prominent of the early flowering plants the *Viola pedatifida*, *V. pedata*, *Arabis lyrata*, *Phlox pilosa*, *Silene antirrhina*. Later *Ceanothus americanus*, *Delphinium azureum*, *Solidago rigida*, *S. nemoralis*, and *Rosa blanda*. These hills become quite dry late in summer and show little else than the dried blades of the grasses mentioned above.

Tree Covered Slopes.—The most conspicuous of the trees in the upper slopes are *Betula papyrifera*. On the shady slopes *Carpinus caroliniana*, *Ostrya virginica*, *Tilia americana*, *Juglans cinerea*. Lower slope, *Quercus rubra* and *Q. alba*, *Acer nigrum*, *A. rubra*, *Pinus strobus*. The hazel, *Corylus americana*, is common everywhere as are *Prunus americana*, *P. virginiana*, *Pyrus ioensis*. The herbaceous undergrowth consists of *Convolvulus spithameus*, *Sanguinaria canadensis*, *Panicum macrocarpon*, *Dodecatheon media*, occasionally *Cerastium vulgatum*, *Cypripedium pubescens*, *Viola palmata* var. *Cucullata*, *V. pubescens*, *Geum album*, *Eatonia pennsylvanica*, *Geranium maculatum*, *Podophyllum peltatum*, *Convolvulus spithameus*, *Asarum canadense*, *Hydrophyllum virginicum*, *Trillium erectum*, *Hepatica acutiloba*, *Anemone nemorosa*, *Arisema triphyllum* are among the more important of the herbaceous plants. Altitude and situation determine the abundance of one or more of these plants. The *Asarum*, *Trillium* and

Arisæma, *Hydrophyllum appendiculatum* occurring in the rich black sandy humus near the bases of the bluffs. The *Acer nigrum* is common only along the west slopes of the Mississippi on the Wisconsin side and east slopes on the Minnesota side of the river. The *Acer nigrum*, however, reaches its greatest development in the Kickapoo valley and its tributaries. In the smaller valleys away from the Mississippi River the species is rare. Such is, however, not the case in northeastern Iowa. The *Acer rubrum* is an extremely rare species along the Mississippi River, only a few trees occurring and these not on the moist, sand-covered slopes as in the Kickapoo valley and its tributaries, but on the border of tamarack marshes. In the Kickapoo valley the moist covered slopes have the following assemblage of plants: *Acer spicatum*, *A. nigrum*, *A. rubrum*, *Dicervillea trifida*, *Quercus rubra*, *Q. macrocarpa*, *Q. tinctoria*, *Taxus canadensis*, *Corylus rostrata*, *C. americana*, *Juglans cinerea*, *Tilia americana*, *Tsuga canadensis*, *Pinus strobus*, *Cypripedium pubescens*, *Asarum canadense*, *Trillium erectum*. The *Tsuga canadensis*, *Clintonia borealis*, *Epigæa repens*, *Coptis trifolia* and *Gaultheria procumbens* are very local. The rock in the Kickapoo valley is often on the surface and this largely accounts for the presence of the plants found here. The soil, too, is quite moist, much more so than the deeply eroded valleys along the Mississippi River.

The Lower Clay Slopes.—The kind of vegetation found on the lower slopes depends on the slope and altitude. Towards the upper portion of the region it is often more or less sandy; the further up, the more it has become impregnated with silica. The sunny slopes were in early times covered with both *Quercus macrocarpa* and *Q. tinctoria*, the former species predominating in Wisconsin and Minnesota while the *Q. macrocarpa* becomes more numerous in northeastern Iowa. *Ranunculus fascicularis*, *Cerastium vulgatum*, *Poa pratensis*, *Geum album*, *Silene stellata*, on the shady slopes *Quercus alba*, *Q. rubra*, *Panicum macrocarpon*, *Cypripedium pubescens*, *Poa pratensis*, *Pyrus iowensis*, *Prunus americana*, *P. virginiana*, *Corylus americana*. These slopes in early days were good agricultural lands and were cropped until they were no longer remunerative. They are now largely turned into pasture and meadow lands. On rich soil *Trifolium pratense*, *T.*

repens, *Agrostis alba*, *Poa pratensis*, *Poa compressa*, *Phleum pratense* grow admirably. *Poa pratense*, *Poa compressa* and *Agrostis alba* are excellent soil-binding grasses and hold the loose soil.

The Higher Alluvial Bottoms.—These occur along the streams in small attached areas. Many of the areas along the smaller streams, before they were brought under cultivation, were marshes. The soil is very rich, often consisting of three or four feet of black alluvial soil, brought down from the hills. These alluvial bottoms were covered quite uniformly with trees of the following species: *Acer saccharinum*, *Tilia americana*, *Ulmus americana*, *Populus monilifera*, *Quercus rubra*, *Carya amara*, *Fraxinus viridis*, and occasionally *Juglans nigra*. The *Arisæma triphyllum*, *Helianthus grosse-serratus*, and *Allium tricoccum*. The absence of *Betula nigra* and *Quercus bicolor* is to be noted.

The Mississippi Alluvium.—The alluvium of the Mississippi River consists of detached and broken sandy prairies in places, as on Goose and other larger islands which are not covered with water some years. Other portions are annually covered with water. The latter may again be divided into the wooded areas and small grassy islands and marshes. On the former the more conspicuous trees are *Acer saccharinum*, *Ulmus americana*, *Betula nigra*, *Populus Monifera* *Quercus bicolor*, scattered, *Fraxinus viridis* and occasionally *Quercus rubra*, and near the mouth of the Root River *Morus rubra* and *Gymnocladus dioica*.

The grassy islands and marshes contain as conspicuous plants *Lobelia cardinalis*, which form great red banks, *Dulichtrium spatulæum*, *Aster tradescanti*, *Poa scratina*, and *Boltonia asteroides*. A large assemblage of other plants will be considered in connection with the vegetation of marshes.

St. Croix Sandstone Ledges.—These ledges contain a large number of interesting plants. Many of the species are very local in their distribution. The kind of plants is largely determined by the altitudes and strata. The lower water-bearing strata consists of fine sandstone with a water-bearing strata from the base of which numerous springs arise. Along the upper slopes *Pinus stroba* and *Texas canadensis*, as well as *Betula lenta*, are conspicuous trees, while close to the springs *Alnus incana* occurs. The

ferns are, however, the most interesting. We have here two species of *Phegopteris*, *P. dryopteris* and *P. polypodioides*, *Lycopodium lucidulum*, *Asplenium Filix-femina*, *Aspidium spinulosum* var. *dilatatum*, *Pellaea gracilis*, *Mitella diphylla*, and along the Kickapoo *Sullivantia ohionis*, *Clintonia borealis*, *Epigaea repens*, *Gaul-*



FIG. 11. Top of clay ridge formation with limestone outcrops. *Carpinus ostrya* and *Quercus* on side hills. Photograph by L. H. Pammel.

theria procumbens, *Circæa alpina*, *Cornus circinata*, *Aralia nudicaulis*, *A. racemosa*, *Acer spicatum*, *Oenothera fruticosa* and *Aquilegia canadensis*.

On the dry rock *Woodsia obtusa*, *W. ilvensis*, *Melica mutica*, *Poa nemoralis*, *Arabis lyrata*, *Campanula rotundifolia*, *Danthonia*

spicata and *Vaccinium pennsylvanicum*. Some of these species, like *Vaccinium* and *Woodsia ilvensis*, are quite rare, the former, however, more widely distributed in the Kickapoo valley.

Rocky Limestone Talus.—This talus, as well as the vertical cliffs, contain an abundance of *Pellaea atropurpurea*, *Campanula rotundifolia*, and in moist situations *Dodecatheon media*. The *Camptosorus rhizophyllus* only occurs upon the talus near the base of the hills. *Arabis lyrata*, *Poa pratensis*, *Eatonia obtusata* and *Koeleria cristata* are common as well as *Cornus alternifolia* and *Rubus strigosus*. These two species, however, occur on sandy slopes.



FIG. 12. St. Croix Area. Sandstone rock. Red Cedar in lower part, *Quercus tinctoria* and *Betula alba*. Photograph by Charlotte M. King.

Tamarack Swamps, Bogs and Marshes.—These have many plants in common. The bogs also have some plants in common with the marshes and tamarack swamps, but the number is small compared with those common to the tamarack swamp and the marsh.

The sphagnum bog has quite a number of plants peculiar to it. Sphagnum bogs in the region are very small and few in number. Some of these bogs have disappeared because of the filling up with drift material from the surrounding St. Croix sandstone outcrops. These areas, owing to the removal of the timber and

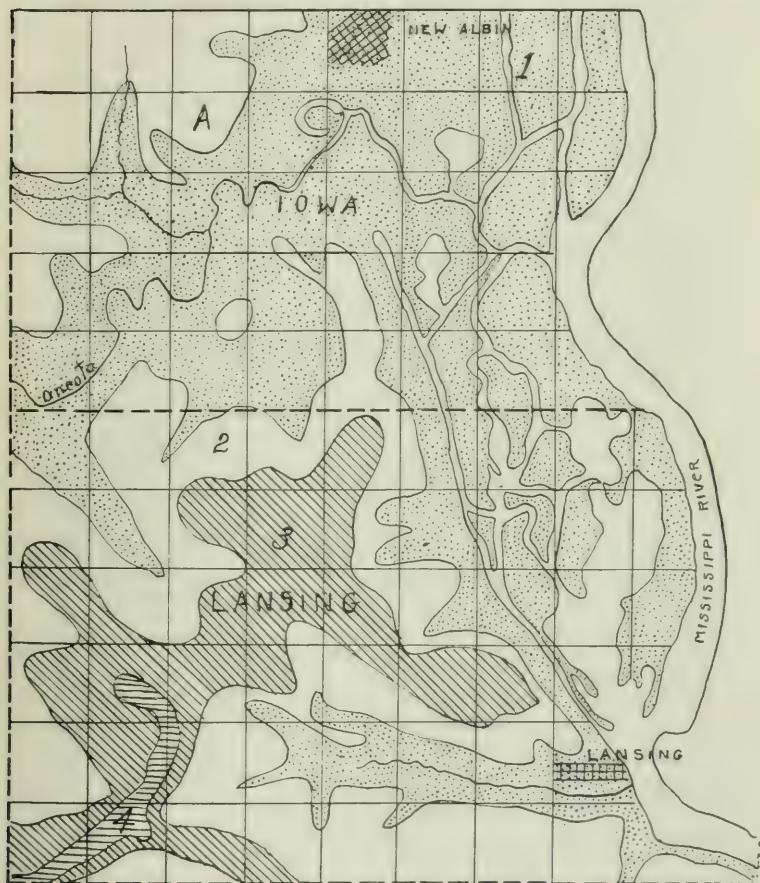


FIG. 13. Topographic Map of Northeastern Iowa. 1. St. Croix. 2. Oneota. 3. St. Peter. 4. Trenton after Calvin.

cultivation of the soil, have washed greatly. In some cases these bogs have been filled with two or three feet of loose drift soil. We will therefore consider the plants under three heads—the tamarack swamp, sphagnum bog and the marsh.



FIG. 14. St. Croix sandstone, *Tilia americana*, *Acer nigrum*, *Quercus tinctoria*, *Acer rubrum*, *Trillium grandiflorum*. Photograph by L. H. Pammel.

Tamarack Swamp.—The term here is used to designate those moist areas in which the *Larix americana* is the most characteristic tree. The Tamarack forms solid groves. No other tree seems to have adapted itself to these areas.* In the north, as in

*For an account of the ecology of the vegetation of our northern woods see the paper of Conway MacMillan, "On the Occurrence of Stagnant Atolls in Central Minnesota." Minn. Bot. Stud. Geol. and Natural Hist. Surv. of Minn. Bull. 9: 2.

N. Whitford. Bot. Gazette, 31: 315.

Observations on the Distribution of Plants Along the Shore of Lake of the Woods. Bull. 9: 949.

the Cass Lake and Leech Lake country in Minnesota, *Abies balsamea*, *Picea nigra* and *Thuja occidentalis* are associated with the tamarack. The *Acer rubrum* is rare in the region close to the Mississippi and occurs only on the margin of the swamp. Of the shrubs the following are quite common: *Rhus venenata*,



FIG. 15. Trunk of Hemlock (*Tsuga canadensis*), Bloomingdale, Wisconsin. Sandy loamy soil. *Cornus circinata*, *Fragaria vesca*, *Gaultheria procumbens*, *Epigaea repens*, *Diervilla trifida*, *Circæa alpina*, *Pellæa gracilis*, *Smilacina bifolia* on the sandy, moist rock; also *Acer spicatum*. Photograph by L. H. Pammel.

Cornus stolonifera, *Nemophanthes canadensis*, *Betula pumila*, *Ampelopsis quinquefolia*, *Uiburnum opulus*, *Juniperus communis*, *Salix candida*, *S. discolor*, *S. rostrata* and *S. lucida*, the *Cypripedium*

spectabile, *C. arictinum*, *Caltha palustris*, *Osmunda cinnamomea*, *O. regalis*, *Aspidium cristatum*, *A. noveboracense*, *Pyrola rotundifolia*, *Valeriana edulis*, *Rubus triflorus*, *Potentilla palustris*, *Coptis trifolia* and *Smilacina trifolia*. The *Saxifraga pennsylvanica*, *Thalictrum purpurascens*, *Lysimachia thrysiflora* and *Caltha palustris* are widely distributed.



FIG. 16. Low sandy alluvium along the Mississippi River near La Crosse. *Acer saccharinum*, *Populus monilifera*, *Fraxinus viridis*, *Quercus bicolor*, *Aster Tradescanti*, *Leersia virginica*. Photograph by L. H. Pammel.

Sphagnum Bogs.—The sphagnum is a dominant plant. Equally common is the *Menyanthes trifolia*, which blooms during the month of July. *Sarracenia purpurea* is found nowhere else in the region.

It occurs not only over the bog, but on the margin. Other rare plants in the region are the following: *Rhynchospora alba*, *Pogonia ophioglossoides*, *Calopogon pulchellus*, *Eriophorus virginicum*, *Salix candida*, *Betula pumila*, *Drosera rotundifolia*, *Lobelia kalmii*, *Bidens beckii*, *Cicuta bulbifera*, *Cnicus miticus*, *Parnassia carolinians*, *Os-*



FIG. 17. *Cypripedium spectabile* in Tamarack marsh with *Ampelopsis quinquefolia*, *Cornus stolonifera*, *Larix americana*, *Osmunda regalis* on the ledges of the swamp in sandy wet soil, along with *Osmunda cinnamomea* and an occasional *Acer rubrum*. Photograph by L. H. Pammel.

munda regalis, *O. cinnamomea*. *Pyrola rotundifolia* and *P. elliptica* are found on the shores or on the small hummocks found in the bogs where sufficient soil has accumulated.



FIG. 18. *Sarracenia purpurea* occurring with *Pogonia*, *Drosera*, and *Sphagnum* moss in bogs. Photograph by Charlotte M. King.

Wet Marshes.—The marshes are drier than the bogs, still they contain considerable moisture and are wet during the entire year. From these marshes come perennial springs. Where these are of sufficient size they form small streams. These are lined with

several species of willow, like *Salix discolor* and *S. richardsoni*. The *S. candida* and *S. lucida* are confined to the marshes in proximity to the tamarack swamp and sphagnum bog. *Alnus incana* and *Cornus stolonifera* are characteristic shrubs. The *Viburnum opulus* and *Betula pumila* are more restricted in their distribution. *Saxifraga pennsylvanica*, *Thalictrum purpurascens*, *Viola blanda*,



FIG. 19. Edge of Tamarack Swamp in La Crosse County, Wisconsin. *Phragmites*, *Salix lucida* and *Cornus stolonifera*. Photograph by L. H. Pammel.

Iris versicolor, *Glyceria nervata*, *G. arundinacea*, *Parnassia caroliniana*, *Lilium canadense*, *Pedicularis lanceolata*, *Lycopus sinuatus*, *Mentha canadensis*, *Stachys palustris*, *Gentiana crinita*, *G. andrewsii*,

Castilleja coccinea, *Heracleum lanatum*, *Valeriana edulis*, *Cnicus muticus*, *Archangelica atropurpurea*, *Conium maculatum*, *Cardamine rhomboidea* and *Bromus kalmii* are common plants of general distribution in these marshes. The *Cypripedium candidum*, *Caltha palustris*, *Viola blanda*, *V. carina* var. *muhlenbergii* and *Symplocarpus fetidus* are local plants found in proximity to springs.

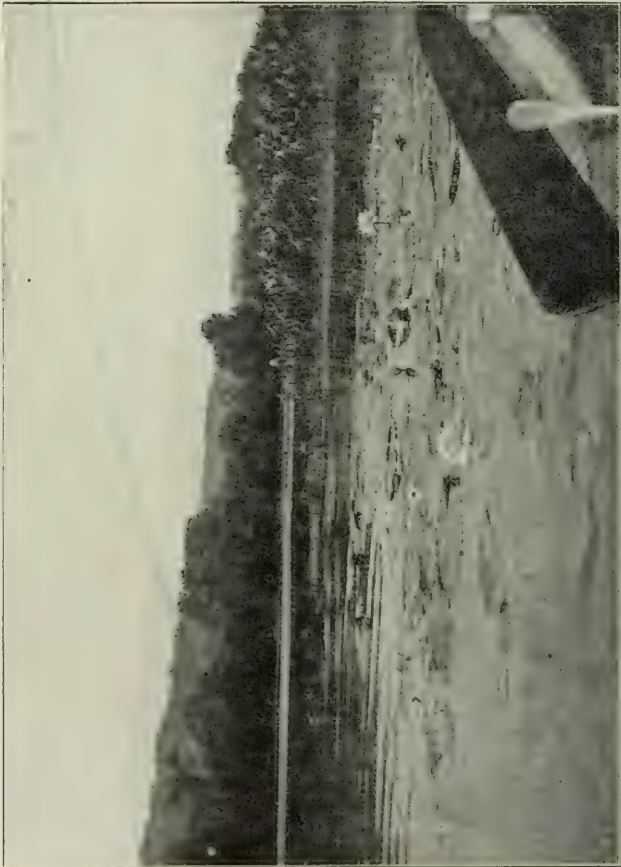


FIG. 20. *Nymphæa tuberosa* in slow-running streams and sloughs near Lansing, Iowa. Photograph by Charlotte M. King.

Alluvial Marshes.—These marshes are often very wet in the spring and influenced by standing water in the spring and early summer. These marshes border the larger streams. They cover much of the area of the Mississippi and Black rivers. Close to

the shore lines of the "sloughs" the *Zizania aquatica*, *Scirpus atrovirens*, *Leersia virginica*, *Dulichium spathaceum*, *Boltonia asteroides*, *Aster tradescanti*, *Sparganium eurycarpum*, *S. simplex*, *Pontederia cordata*, *Alisma plantago*, *Sagittaria variabilis*, *Heteranthera graminea*, *Acorus calamus*, *Typha latifolia*, *Mimulus ringens*, *Lobelia cardinalis*, *Panicum crus-galli*, *Ilysanthus riparia*, *Hemicarpha subsquarrosa* and *Lythrum elatum*. The *Lythrum* develops æerenchyma along the lower part of the stem, its function being to protect the plant when it becomes immersed.



FIG. 21. Balsam Fir (*Abies balsamea*), *Betula papyrifera*, *Pyrus arbutifolia*, *Corylus rostrata*, *Circæa alpina*, *Quercus rubra*, *Acer spicatum*, *Viburnum opulus*. In open places, *Aconitum uncinatum*. Photograph by L. H. Pammel.

Aquatic Vegetation.—The *Nuphar advena* is widely distributed in ponds and sloughs. The *Nymphaea tuberosa* occurs in the small lakes and slow-running sloughs. The *Nelumbo lutea* occurs in a few places also in slow-running water. The *Elodea canadensis* and *Vallisneria spiralis* are widely distributed in ponds and slow-running streams. *Ranunculus multifidus* and *R. aquatilis* var. *trichophyllus*, *Lemna trisulca*, and *L. minor* as well as *Polamogeton*

heterophyllus, *P. natans* and other species are common. The *Mimulus jamesii* is local.

Development of the Swamp.—The region here is peculiar in that there is no evidence of glacial action in the formation of lakes. Inland lakes, or more properly ponds, are of rare occurrence in the region of Minnesota and southwestern and north-eastern Iowa under consideration. Away from the streams only a very small number of ponds or lakes occur. The one described here occurs in State Road Coulé and is of comparatively recent origin. The present small creek in State Coulé once had its course along the west side of the bluffs, but by the accumulation of sedimentary material a few miles south cut through an alluvial flood plain, the water sinking away in large part in the loose sandy soil some two miles south of the mouth of the small valley, joining, however, the old channel in time of high water. The accumulation of water from springs at the base of the hills forms a small lake with a marsh of some size at the lower end. Around this lake there occur *Scirpus lacustris*, *Lemna major*, *L. trisulca*, *Elodea canadensis*, *Potamogeton natans* and *Hippuris vulgaris* and *Ranunculus aquatilis* var. *tricophyllus*. The *Spirogyra*, *Zygnema* and *Desmids* are the most important of the hydrophytic plants. On the muddy shore lines *Eleocharis acicularis*, and *E. palustris* and further out the *Acorus calamus*, *Caltha palustris*, and *Symplocarpus fetidus*, *Iris versicolor* and *Phragmites communis* form the border of the lake. The ground surrounding the pond is elevated and the vegetation here consists largely of *Glyceria nervata*, *G. arundinacea*, *Phalaris arundinacea*, *Castilleja coccinea*, *Burnus kalmii* and *Campanula aparinoides*, but especially of sedges. The *Scirpus lacustris* and other aquatic plants no doubt were the forerunners of the present marsh vegetation surrounding the pond. *Nuphar*, *Nymphaea*, and *Nelumbo*, aquatic plants of the Mississippi, do not occur. Nicholas Whitford,¹ in describing the development of glacial swamps in northern Michigan, states as follows: "Most swamps start as ponds or lakes, in which water-lilies and other pond plants dominate. On the borders of the pond sedges appear; these, by their decay, build up a soil, and thus prepare the way for the next zone, the *Cassandra-sphagnum* vegetation. The sedges encroach farther on

1. Bot. Gazette, 31: 313.

the original lake. The Cassandra-sphagnum zone makes conditions possible for a tamarack-spruce zone. Thus each successive zone is pushed farther and farther toward the center. Finally the lily center disappears, and then successively the sedge and Cassandra zones, until a tamarack forest may come to occupy the whole territory."

The bottom of the pond consisted of peat mixture lying on a brown sandy soil. The water is derived from perennial springs. The soil is not typical peat but a mixture of considerable humus and some sand. Two other typical swamp areas may be considered. One, a tamarack marsh in the town of Campbell. This was formed by the accumulation of sand and alluvium at the mouth of the present marsh, where it joins the La Crosse River.

During times of high water this area was filled with water in which aquatic plants probably like *Nuphar*, *Nymphaea*, *Scirpus*, and *Elocharis* formed the principal vegetation. These by decay formed humus which gradually filled the lake and thus gave rise to a bog. As the filling process continued the *Larix americana* made their appearance. Prof. L. H. Harvey¹ in his paper on a study of the physiographic ecology of Mt. Katadin finds in his studies of the sphagnum bog society that the sphagnum advances from the edge, finally the open space is spanned, sufficient soil is formed to permit *Scheuchzeria palustris* to grow; and with more soil *Sarracenia purpurea*, *Vaccinium macrocarpon*, *Smilacina trifolia*. With drier conditions *Eriophorum* and *Carex trisperma* are important constituents. These are followed by *Cassandra calyculata*, *Kalmia angustifolia*, and *K. glauca*. In our bogs we find neither *Kalmia* nor *Smilacina trifolia*. The *Smilacina* is an abundant constituent of the tamarack swamp. The *Vaccinium*, however, is common as *Eriophorum*. The *Picea nigra* is given as the pioneer for the Mt. Katadin bog. Whitford² speaks of a tamarack-spruce zone following the Cassandra. Coulter³ in a paper, "An Ecological Comparison of Some Typical Swamp Areas," refers to the formation of the bogs on North Manitou Island as follows:

"The peat mosses which thrive so luxuriantly in poorly drained conditions are among the pioneer forms concerned in

1. The University of Maine Studies, 5: 43.

2. l. c. 314.

3. Rept. Mo. Bot. Garden, 15: 43.

this process, while the cranberry (*Vaccinium macrocarpon*) quickly follows and soon forms a foothold for the leather-leaf (*Cassandra calyculata*) and allied forms.

"On the land margin the tamaracks and spruces are closely crowding on the shrubs, and back of these, the hemlock-maple-beech forest is encroaching on the conifers."

"The zonal distribution of plants is well illustrated in these tamarack swamps. Within the surrounding forest of maple,



FIG. 22. *Zizania aquatica* on border of wet marsh. Photograph by Charlotte M. King.

beech, and hemlock, the real swamp area is found. The surface of the peaty soil is covered with sphagnum and this zone is dominated by *Larix americana* and *Picea nigra*."

The spruce is absent in western Wisconsin because of climatic conditions, its range being more northward. There are, however, isolated small spruce swamps forty or fifty miles eastward. The arbor vitæ mentioned elsewhere as occurring mixed with tamarack and balsam in northern Minnesota is also more north-

ern in its distribution. However, eastward the species occurs on the St. Croix sandstone along the Wisconsin River associated with *Pinus resinosa*, *P. strobus*, and *Pyrus americana*. Trees frequently follow the courses of streams where they obtain a meager foothold. This is true of the *Quercus bicolor*. The *Acer rubrum*, which to the north and east occurs not only along streams but associated with the white and Norway pine, is in its most western part in Wisconsin found on the border of the tamarack swamp. This tamarack swamp is not only too wet, but the soil condition, probably because of its acidity, is unsuited for the *Acer saccharinum*, *Ulmus americana* and the other alluvial types; hence the line of tension is not so great, permitting the red maple to get a foothold. The tamarack, because of its wide adaptability, occupies a place that no other tree so readily occupies in these marshes. Under cultivation the tamarack succeeds admirably in clay soil everywhere in the region.

These bogs, however, did not form generally in the region. This particular *Larix* swamp and bog lies between low hills. The strata below consists of a fine sand which is highly retentive of moisture and hence made the conditions favorable for the formation of a bog. Adjoining the swamp and in numerous places along the smaller streams are wet marshes which are frequently more or less sloping or but a few feet above the flood plain of the streams and hence, during freshets, covered with water. The sphagnum bog, before the removal of the timber above it, received clear water, but since the cultivation of much of the land above it has become covered with sand to such an extent that its characteristic plants have been obliterated. The *Menyanthes trifolia* is making a vain attempt to persist, *Sarracenia*, *Drosera*, *Eleocharis* and *Pogonia* having entirely disappeared. The *Larix americana* is not common in La Crosse county. The seed was probably carried to the La Crosse River from the country to the north. A second tamarack marsh in La Crosse county occurs in Mormon Coulé, some fourteen miles south. There is no longer a sphagnum bog surrounding or in close proximity to the tamarack grove. The coulé at this point is about one mile wide. The flat area here is wider than at any other point along the creek. The stream is small. A mile below the valley narrows. The soil in proximity to the tamarack marsh is very rich. All evidence seems to show

that we had here an ancient lake which has to a large extent been drained. The region surrounding the grove is still very swampy, but there is no evidence anywhere of a typical sphagnum bog with its accompanying plants like *Sarracenia purpurea*, *Drosera rotundifolia* and *Pogonia*. However, *Salix candida*, *S. lucida*, *S. discolor* and *Aspidium noveboracense* are abundant. The vegetation here is similar to that of the first area here considered. The tamarack swamp is a typical forest island; the seeds were undoubtedly carried by the wind from the La Crosse valley. These marshes are numerous provided with springs and, where there is sufficient fall, form small runs along whose courses the *Salix rostrata*, *Alnus incana* and *Cornus stolonifera* are abundant. As the drainage became more perfect the elevated flat areas bordering on the swamp became covered with shrubs and trees, finally culminating in a growth of trees like *Populus tremuloides*, *Tilia americana*, *Ulmus americana*, *Fraxinus* and *Quercus rubra*.

The Development of Plants on the St. Croix Sandstone.—Some of the slopes are bare of tree forms, as they have been for ages. The location of the slope and altitude are, however, important factors. The bare slopes are peculiar to the region adjacent to the Mississippi River both on the Wisconsin and Minnesota sides of the river. Away from the river these "bald" areas are smaller. The north slopes are generally covered with a tree growth. East and south exposures, as well as some of the southwest exposures, are treeless. Prof. T. H. Macbride¹ accounts for it in this way:—

"North slopes in our latitudes are for only a few months exposed to the sun at all; eastern slopes have the advantage of the dewfall and the coolness of the night before meeting the heat of the morning sun, while the south slopes lie all day long beneath the hottest rays, and the west endures the heat of the afternoon. In the second place, our prevailing winds being from the west, the greatest amount of snow is always lodged on eastern or southeastern slopes. Of all these conclusions Allamakee county shows us a remarkable confirmatory illustration. The observer has but to drive across the country anywhere to discover that the southwestern sides of all the rounded knolls and hills are bare; always have been."

1. Rept. Iowa Geol. Survey, 4: 116.

There has been a remarkable change in the character of the vegetation of these hills within the memory of man. The absence of trees here has been in part accounted for by the prairie fire. It is, however, only one of the causes. Formerly "prairie fires," as they are called, could be seen in all directions during the month of April. They would burn the entire areas except the shaded north and northeast slopes where the snow remained longer and the soil and dead grass was too moist for a good blaze. Since the checking of these fires forest growth has expanded. It has gradually encroached upon some of the bare slopes. In a paper on the forest condition in western Wisconsin the following statement was made:¹ "During the past thirty years some important changes have taken place in the growth of timber along the river. The pioneer settler found little timber on the hills except those with a northern slope. The timber standing on the sunny sides was usually poor in quality, owing to numerous fires. Now these lands are mostly fenced, and fires are kept out, at least by the more enterprising farmers. The bleak hills are being rapidly covered with a forest growth.

"It is not an uncommon thing to observe patches of Hazel (*Corylus americana*, Walt.) beyond the outskirts of the timber; here, in the course of a few years, will be found Oaks, Birches, Hickories, and Poplars. The humus formed where Hazel grows is extremely rich and fertile, and I doubt whether trees could cover our treeless hills very fast without its help."

Since making this statement the region has been visited several times and I have not altered my views. The mesophytic forest has extended and encroached on the grass covered Saint Croix area.

It is evident that such species as *Andropogon scoparius*, *Delphinium azureum*, *Viola pedatifida*, *Lithospermum hirtum* and *Castilleja sessilifolia* are the forerunners for a mesophytic shrub growth, the most important of all these plants being *Rhus glabra*, *Ceanothus americanus*, which appears with the *Andropogon* and *Viola*. The *Rosa blanda* and *Ceanothus* are widely scattered where the *Rhus* forms copses. The *Corylus* shows a long step in advance of the *Rhus*; the collection of a good humus and an abundance of loose soil put it in a good condition for the growth of *Betula*

1. Garden and Forest, 4: 462.

papyrifera, *Prunus americana*, and *Quercus tinctoria*. It is only on the very dry slopes that *Quercus macrocarpa* appears. The older the forest becomes and the more humus and decayed organic matter is found, the more favorable the region becomes for the *Quercus rubra* and *Q. alba*. Occasionally these outlying situations, especially the more moist and lower hill slopes, contain *Pinus strobus*, a tree limited along the Mississippi from La Crosse southward to these sandstone rocks. However, in



FIG. 23. Upper part of tree of *Abies balsamea* heavily loaded with cones. Photograph by L. H. Pammel.

the northern part of this and Trempleau counties the species is common in sandy oak openings. Eastward in the Kickapoo valley it occurs not only in the moister valleys but also along the sandy St. Peter's sandstone ridges. The line of tension between the white pine and deciduous trees is so great along the St. Croix sandstone that it occupies somewhat inaccessible areas.

Yellow River Region in Allamakee County.—The area about Myron must be considered separately. With Mr. Ellison Orr and Mr. D. O. Wilson, a day was spent early this summer in an investigation of this interesting region. The area here considered is on the north slope of a hill, with the Yellow

River flowing at its base. The Yellow River is a stream of considerable size, having its source from several streams from one-half to three-quarters of a mile above the place where the Balsam Fir occurs. Temperature records taken of the soil one inch down at random indicated that the soil was much cooler than that of the surrounding woody hills and bluffs. The limestone rock is extremely porous and all through it are caverns of various sizes. From these caverns during the summer cold air is constantly issuing. At one point where the rock was covered with mosses, consisting of *Hypnum tamariscinum* and *Anomodon minor*, the temperature was 46°F. The highest temperature found in open places was 63°, at a depth of one inch. At other points the temperature varied from 56° to 60°, showing that one of the most important factors in connection with the boreal plants developed here is the temperature. The temperature of the air was 75°.

The stretch of Balsam Fir woods extends from about one-half to three-quarters of a mile on the north slope of a hill. The Balsam Fir, the White Pine¹, *Pyrus arbutifolia*, *Corylus rostrata*, *Dicervilla trijida*, *Betula papyrifera*, *Lonicera glauca*, *Aralia quinquefolia*, *A. racemosa*, *Bromus purgans*, *Poa nemoralis*, *Campanula rotundifolia*, *Aquilegia canadensis*, *Hydrophyllum virginicum*, *Taxus canadensis*, *Sambucus racemosa*, *Phegopteris calcarea*, *Acer spicatum*, *Aconitum uncinatum*, *Viola blanda*, *Saxifraga pennsylvanica* and *Arabis lyrata* were distributed throughout the region. The *Poa nemoralis*, *Arabis lyrata* and *Campanula americana* occurred upon the limestone rocks with little soil. They occurred with numerous species of lichens, of which the following are prominent: *Buellia albo-atra*, *Lecanora praeigna*, *L. calcarea* var. *contorta*, and *L. muralis* var. *versicolor*. The *Polypodium vulgare*, *Circæa alpina* and *Cypripedium pubescens* were more or less local. Most of the limestone rock has become covered with vegetation. It is only in the drier places that the *Arabis lyrata* thrives. The *Saxifraga pennsylvanica*, *Viola blanda* and *Bromus kalmii* occur in the moister places.

Flora of the Wisconsin Drift.—There are three types of plant formations on the Wisconsin drift. First, the flora of the larger

1. *Pinus strobus*.

valleys of streams, second, the flora of the bogs and marshes, and third, of the prairies. The first has been considered in connection with the flora found along the Des Moines, the Iowa and other streams.

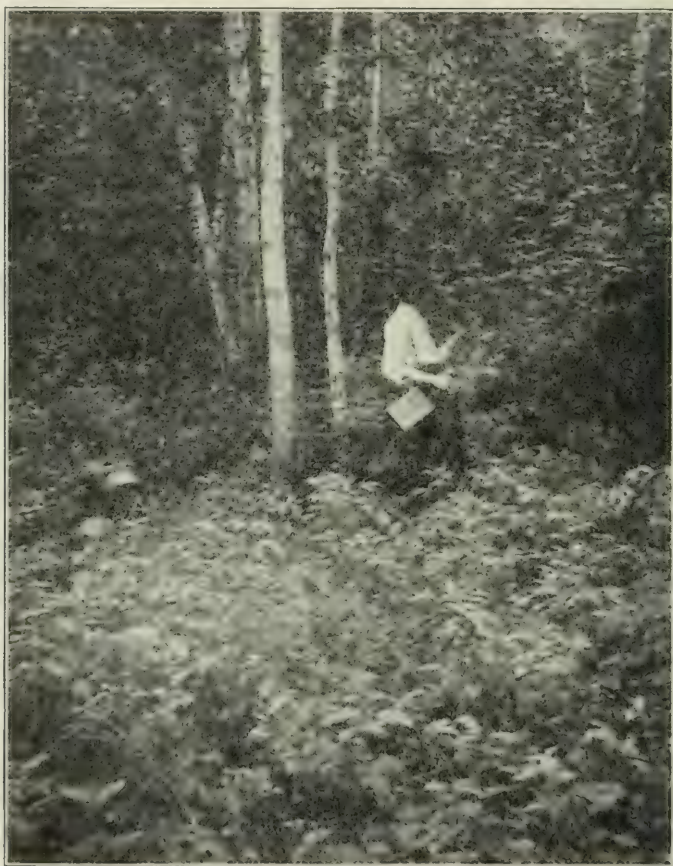


FIG. 24. In the interior of a group of White Birches, *Betula papyrifera* and *Corylus rostrata*, *Pyrus arbutifolia*, covering the ground in the foreground. Photograph by L. H. Pammel.

In Hamilton, Story and Wright counties, ancient lake beds are numerous, but nowhere do they present as many typical boreal plants as in Cerro Gordo, Hancock and Worth counties. In Hamilton county the old Mud Lake was a shallow body of

water covering about fourteen hundred acres. The depth of the water was only a few feet in most places, varying with the amount of rainfall. The marginal flora of the lake consisted largely of *Scirpus lacustris*, *Typha latifolia*, *Zizania aquatica*, and *Nymphaea tuberosa*. On the margin, in marshy ground, *Iris versicolor*, *Scirpus atrovirens*, *Eleocharis palustris* formed the most characteristic plants before its drainage.

Generally speaking, the flora of the Wisconsin drift contains the characteristic prairie vegetation not unlike that of other western prairie states. The several species of *Liatris*, its broad



FIG. 25. *Nelumbo*, Mississippi River, near Redwing, Wisconsin side. Photograph by J. E. Guthrie.

waving fields of *Andropogon* accompanied by *Phlox pilosa*, *Panicum scribnerianum*, *P. virgatum*, *Vicia americana*, *Geranium maculatum*, *Rosa blanda* var. *arkansana*, *Ceanothus americanus*, *Echinacea purpurea*, *Lithospermum canescens*, *L. angustifolius*, *Viola palmata* var. *cucullata*, *V. pedata*, *Castilleja sessilifolia*, *Astragalus caryocarpus*, *Stipa spartea*, *Ceanothus ovatus*, and *Delphinium azureum*.

The Flora of the Bogs of Cerro Gordo and Worth Counties— These bogs are interesting from a phytogeographical standpoint. We have here representatives of a flora common in Minnesota to the north and the bogs of western Wisconsin. Many species have, however, disappeared in their immigration southward and northward. The conditions favorable for the development of these glacial plants have gradually disappeared, owing to the absence of proper soil and temperature conditions. The long and hot summers greatly increased the heat of the soil and water in which these plants thrive, hence their extermination. A few illustrations will suffice. The *Cnicus muticus*, though common in these bogs, occurs more commonly in Wisconsin marshes that are fairly dry during the latter part of the season. The same may be said of *Parnassia caroliniana*, *Chelone glabra*, *Thalictrum purpurascens* and *Pedicularis lanceolata*. The *Salix candida*, *Lobelia kalmii* and *Cicuta bulbifera* are equally common in the bogs of western Wisconsin and in Worth county. The *Salix richardsonii* and *S. discolor* are found throughout the Wisconsin drift area. The *Hierochloa borealis* hardly reaches the southern end of the Wisconsin drift as it only reaches as far south as Marshall and Hamilton counties. This grass, however, can hardly be classed as a real bog species as it is usually found on moist drift soils further northward. A hasty survey certainly shows that the Wisconsin drift has influenced in a marked manner the flora of northern central Iowa.

A brief list of the plants shows that the sphagnum which constitutes the bulk of the vegetation in the bogs of Wisconsin is entirely lacking in Worth and Cerro Gordo counties, and in place we find *Hypnum*s. The bogs, however, contain a number of most interesting northern plants, among them *Bidens beckii*, *Cnicus muticus*, *Gentiana crinita*, *G. quinqueflora*, *G. andrewsii*, *Parnassia caroliniana*, *Cicuta bulbifera*, *Bromus kalmii*, *Thalictrum purpurascens*, *Salix discolor*, *S. richardsonii*, *S. candida*. The *Salix richardsonii* and *Populus tremuloides* are quite conspicuous shrubs. Owing to the deposit of soil through cultivation these bogs are beginning to "dry up," as the common expression is. Scattered throughout the bogs are small groups of *Populus tremuloides* which in course of time will give rise to a mesophytic forest. In fact, the course of the formation of the forest here is very



FIG. 26. *Gentiana crinita* in marshes and bogs of the Wisconsin drift. Photo. C. M. King

different than in northern Michigan, Wisconsin or Minnesota. The reason for this is no doubt the lack of forest-forming species in the immediate vicinity, the tamarack and spruce both being absent and no seed any where in the vicinity.

STEAMBOAT ROCK.

The Flora of the Flood Plains of the Iowa River.—This formation has in a large part lost its original aspect. The more important trees found here consist of the Soft Maple (*Acer saccharinum*), the Box Elder (*Negundo aceroides*), the Corky Bark Elm (*Ulmus*

racemosa), *U. americana*, *Fraxinus viridis* and *Populus monilifera*. The shore line of the stream has an abundance of *Eragrostis reptans*, *Cyperus erythrorhizos*, *C. diandrus*, *Hemiarpha subsquarrosa*, *Lobelia cardinalis*, *L. syphilitica*, *Leersia virginica*, and *L. oryzoides*.

The second shore line consists of a black sandy humus. But a small proportion of the original forest remains. The chief type of trees found here consists of the Hard Maple (*Acer nigrum*), *Juglans nigra*, *J. cinerea*, *Ulmus fulva*, some *U. americana*, and *U. racemosa*, *Carya amara*, *Quercus macrocarpa*, and *Q. rubra*, *Crataegus mollis* and *C. punctata*, *Pyrus iowensis*, *Prunus amer.*

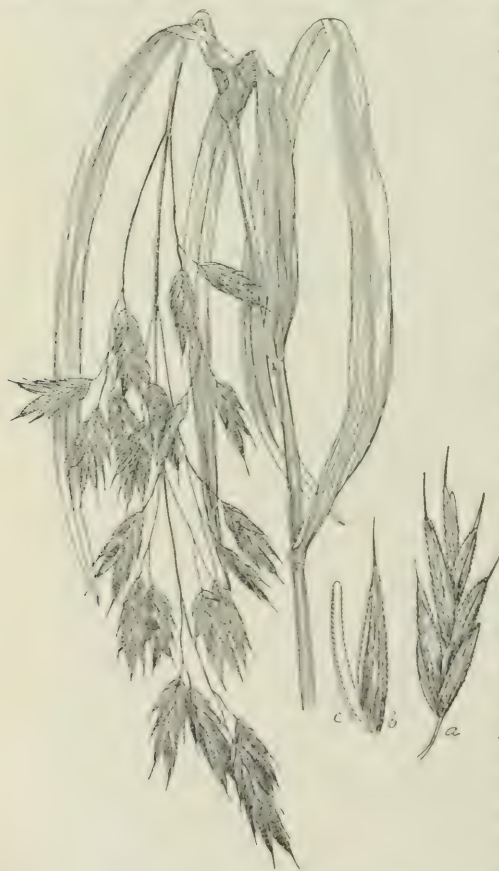


FIG. 27. *Bromus ciliatus* var. *latiglumis*. Common in marshes. Photograph by Charlotte M. King.

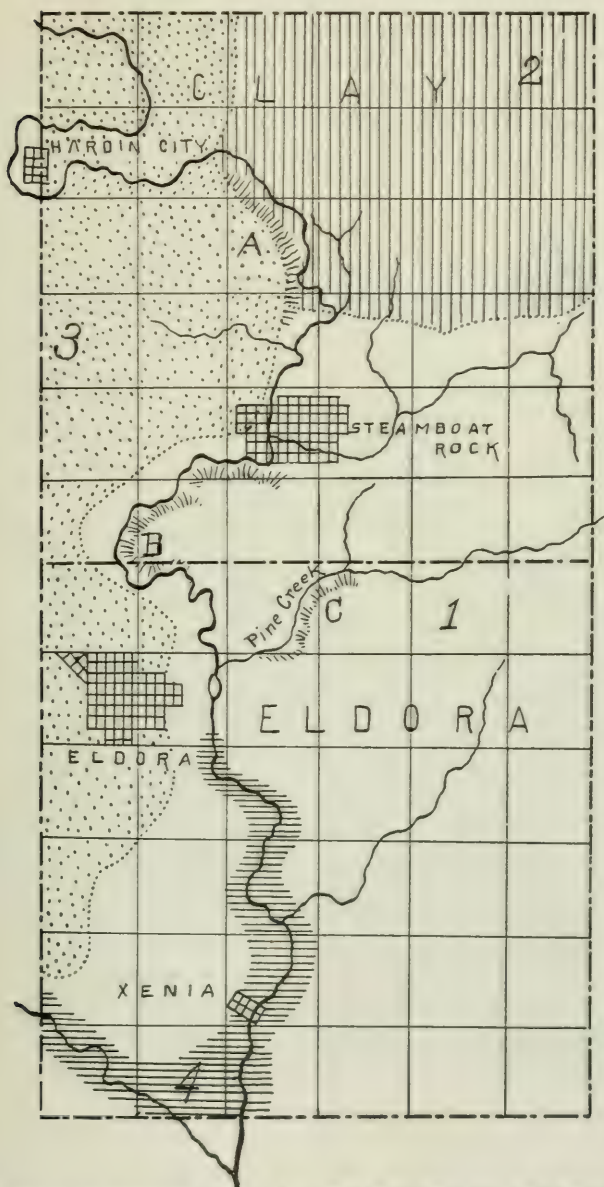


FIG. 28. Map of the Steamboat Rock region. The White Pine along Pine Creek and the Sandy Ledges between Pine Creek and Steamboat Rock. The Cherry Birch at B. 1=Kansan Drift. 2=Iowan Drift. 3=Wisconsin Drift. After S. W. Beyer.

Rocky Talus and Sandstone Ledges.—The rocky talus and sandstone ledges contain an interesting assemblage of boreal plants. The soil is black sandy loam with a rich humus. The narrow strip between the river and the vertical cliffs is shaded and contains a dense mass of plants consisting of several species that are quite rare in the state of Iowa.



FIG. 29. *Pinus strobus*, *Betula papyrifera*, *Cornus circinata*, *Osmunda claytoniana*, *Smilacina trifolia* on Pine Creek, Hardin county. Photograph by Charlotte M. King.

Of the trees, the following are the more important: *Pinus strobus*, *Betula papyrifera*, *B. lenta*, and associated with these trees are the following shrubs: *Cornus circinata*, *Diervilla trifida*, and

Lonicera sullivantii. Of the more common Iowa trees we may mention *Juglans cinerea*, *Quercus rubra*, occasional; *Acer nigrum*, *Juniperus virginiana*, *Crataegus margaretha* and *Amelanchier canadensis*. Of the herbaceous plants the *Aspidium marginale* is abundant for some distance underneath the shaded woods, along with it also the *Aspidium spinulosum* var. *intermedium*, *Polypodium vulgare* and *Phegopteris dryopteris*. The *Lycopodium lucidulum* is rare.

Along Pine Creek, where similar outcrops of sandstone occur but of less height, the White Pine is more abundant, there being trees here that are two to three feet in diameter and 70 or 80 feet high. Along the

shaded places the *Osmunda claytoniana*, *Cornus circinata*, *Diervilla trifida*, and *Cypripedium spectabile* are abundant. Further up the Iowa river along the shaded bluffs where the Iowan drift occurs on steep banks the *Juniperus communis* is abundant. During the spring these banks are very moist. The *Cypripedium spectabile* is not infrequent, and *Salix discolor* and *Dirca palustris* are abundant. This region is always moist. The soil is a deep yellow loam overlaid by a black humus.

Of the many plants occurring upon the dry ledges, attention may be called to *Campanula rotundifolia*, *Danthonia spicata*, *Eragrostis capillaris*, *Lechea major*, *Helianthemum canadense*, *Erig-*



FIG. 30. *Danthonia spicata*, on the dry sandstone rocks. (U. S. Dept. Agrl.)

erion divaricatus and *Draba caroliniana*. In the shaded woods, during the early spring, under the sandstone ledges and elsewhere in the region, the *Trillium nivale*, *Viola pubescens*, *Isopyrum biter-natum*, *Dicentra cucullaria* and *Anemone nemorosa* are abundant.

PERCENTAGE OF TREES.

The percentage of trees found on different formations near Steamboat Rock is here given. The forests of Hardin and Marshall counties during the early days were important in the building of railroads as well as for fuel. It may be of interest, therefore, to give a table showing the percentage of trees on the different formations found in the vicinity of Steamboat Rock.

FORMATION.	SPECIES.	PERCENTAGE.
Sunny, sandy slope.....	<i>Quercus alba</i>	3.3
" " "	" <i>rubra</i>	3.6
" " "	" <i>tinctoria</i>	12.1
" " "	" <i>macrocarpa</i>	12.1
" " "	<i>Ostrya virginica</i>	27.3
" " "	<i>Carya alba</i>	12.1
" " "	<i>Juglans cinerea</i>	9.9
" " "	<i>Tilia americana</i>	9.9
" " "	<i>Prunus serotina</i>	9.6
Rocky, sandy talus	<i>Quercus alba</i>	3.8
" " "	" <i>macrocarpa</i>	19.6
" " "	" <i>tinctoria</i>	26.2
" " "	<i>Prunus americana</i>	6.0
" " "	" <i>serotina</i>	4.6
" " "	<i>Prunus virginiana</i>	26.1
" " "	<i>Populus tremuloides</i>	7.9
" " "	<i>Crataegus mollis</i>	4.6
" " "	<i>Pyrus coronaria</i>	1.2
Sandy loam, north slope.....	<i>Prunus serotina</i>	12.1
" " " "	<i>Juglans cinerea</i>	6.2
" " " "	<i>Ostrya virginica</i>	20.0
" " " "	<i>Acer nigrum</i>	12.0
" " " "	<i>Carya alba</i>	20.0
" " " "	<i>Betula alba</i>	1.9
" " " "	<i>Crataegus margaretha</i>	5.5
" " " "	" <i>punctata</i>	2.2
" " " "	<i>Quercus alba</i>	8.1
" " " "	" <i>rubra</i>	10.0
" " " "	" <i>tinctoria</i>	2.0
Black loam, top of hills.....	<i>Carya alba</i>	12.1
" " " " "	" <i>porcina</i>	3.0
" " " " "	<i>Quercus tinctoria</i>	20.1
" " " " "	<i>Fraxinus americana</i>	2.5

Black loam, top of hills.....	<i>Fraxinus viridis</i>	1.5
" " " " ".....	<i>Tilia americana</i>	18.1
" " " " ".....	<i>Quercus rubra</i>	10.1
" " " " ".....	" <i>alba</i>	10.0
" " " " ".....	<i>Ulmus fulva</i>	20.1
" " " " ".....	<i>Cratægus mollis</i>	2.5

The undergrowth in this forest consisted of *Rubus strigosus*, *Solidago ulmifolia*, *Silphium perfoliatum*, *Aster sagittifolius*, *Celastrus scandens*, *Helianthus strumosus*, *Ribes gracile*, *Cornus sericea*, *Corylus americana*, *Agrimonia eupatoria*, *Solidago canadensis*, *Prunus pennsylvanica*.

FORMATION.	SPECIES.	PERCENTAGE.
Carboniferous Sandstone, shady west slope, from rocky ledge to river.....	<i>Acer nigrum</i>	8.2
"	<i>Acer saccharinum</i>	3.0
"	<i>Fraxinus viridis</i>	4.5
"	" <i>sambucifolia</i>	2.0
"	" <i>americana</i>	2.0
"	<i>Betula papyrifera</i>	4.2
"	" <i>lenta</i>	24.1
"	<i>Amelanchier canadensis</i> ...	10.4
"	<i>Juniperus virginiana</i>	1.0
"	<i>Ulmus fulva</i>	3.0
"	" <i>americana</i>	3.0
"	<i>Pinus strobus</i>	2.17
"	<i>Quercus alba</i>	6.5
"	" <i>tinctoria</i>	4.8
"	" <i>rubra</i>	6.4
"	<i>Carpinus caroliniana</i>	4.4
"	<i>Ostrya virginica</i>	10.4

The undergrowth consisted largely of *Corylus americana*, *Diervilla trifida*, *Aspidium marginale*, *Phegopteris dryopteris*, *Cornus alternifolia* and *C. circinata*.

FORMATION.	SPECIES.	PERCENTAGE.
Sandy alluvial flood plains.....	<i>Populus monilifera</i>	3.1
" " " " ".....	<i>Quercus macrocarpa</i>	5.2
" " " " ".....	<i>Prunus serotina</i>	2.9
" " " " ".....	<i>Quercus rubra</i>	2.9
" " " " ".....	<i>Juglans cinerea</i>	17.4
" " " " ".....	" <i>nigra</i>	15.3
" " " " ".....	<i>Negundo aceroides</i>	3.1
" " " " ".....	<i>Ulmus americana</i>	10.1
" " " " ".....	" <i>fulva</i>	2.4
" " " " ".....	<i>Fraxinus viridis</i>	8.1
" " " " ".....	<i>Acer saccharinum</i>	6.1
" " " " ".....	" <i>nigrum</i>	15.6
" " " " ".....	<i>Pyrus iowensis</i>	2.9
" " " " ".....	<i>Prunus americana</i>	3.1
" " " " ".....	<i>Cratægus mollis</i>	2.5
" " " " ".....	" <i>punctata</i>	2.0

These figures indicate that this sandy alluvial bottom contains species of plants that are common to other places in the region. This is no doubt due, in part, to the fact that the water does not long stand on the soil; then, too, the alluvial soil has a considerable mixture of sandy material, the soil being well drained.



FIG. 31. Part of a Bog in Worth and Cerro Gordo Counties. *Cnicus mutians*, *Salix Candida*, *Lobelia kalmii*, *Bromus kalmii* and *Populus tremuloides* to the right. Photograph by L. H. Pammel.

The bogs of Cerro Gordo and Worth counties may be compared with some very typical swamps in Wright and Hamilton counties. Both of these counties are in the Wisconsin drift area, and the swamps are in a more advanced stage than in the north

and east. These swamps have materially changed since the surrounding country has been brought into cultivation. That these swamps were once lakes, receiving the water from the surrounding country, admits of no doubt. The old beach line is plainly evident. In the larger of these lakes the outer beach was covered with trees and shrubs. Of this arboreal vegetation we may mention *Quercus macrocarpa*, *Ulmus fulva*, *U. americana*, *Fraxinus viridis* and *Tilia americana*.¹ There are few shrubs,—*Corylus americana*, *Rhus glabra*, *R. toxicodendron* and *Symphoricarpos occidentalis*. The smaller lakes are not surrounded by timber or shrubs. The outer beach line, which consists of a sandy gravel and humus, contains *Oenothera serrulata*, *Ceanothus americanus*,

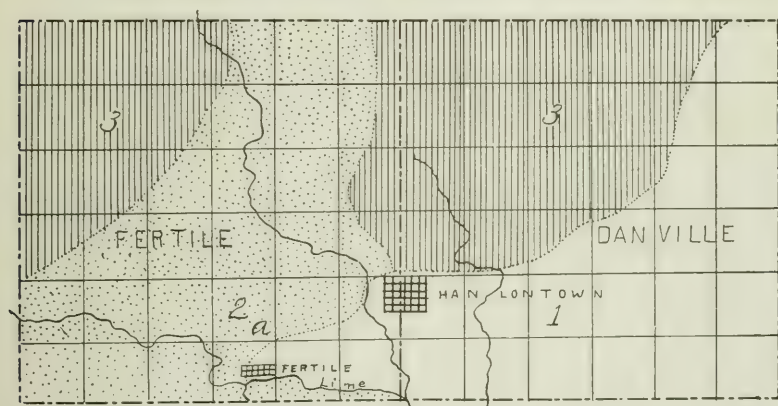


FIG. 32. Drift Sheets in Worth County. 1=Iowan, 2=Wisconsin, 3=Altamont Moraine.

Onosmodium carolinianum, *Verbena stricta*, *V. bracteosa*, *Lithospermum canescens*, *L. angustifolium*, *Castilleja sessiliflora*, *Solidago rigida*, *S. nemoralis*. *Poa pratensis* is abundantly naturalized. The second beach is thickly covered with *Scirpus atrovirens*, *Glyceria nervata*, *Thalictrum purpurascens*, *Juncus tenuis*, *Verbena hastata*, and *Hordeum jubatum*. Formerly *Cypripedium candidum* was common. The third beach is thickly covered with *Carex*, *Iris versicolor*, *Lathyrus palustris*, *Eleocharis palustris*, *Eupatorium perfoliatum*, *E. purpureum*, and *Asclepias incarnata*. The third beach is mostly made up of *Calamagrostis canadensis*, *Glyceria*

1. See L. H. Pammel, "Old Lake Vegetation of Hamilton County, Iowa." *Plant World*, 2: 43.

arundinacea, *Carex*, *Hypericum* and *Scutellaria galericulata*. This beach is followed by an abundant growth of *Phragmites communis*, *Scirpus lacustris*, *Typha latifolia*, *Menyanthes trifoliata* and *Zizania aquatica*. Formerly the center of the swamp was a lake in which *Nuphar advena* and *Nymphaea tuberosa* abounded, but owing to drying of the lakes these have in most instances disappeared. During the spring and early summer months there is an abundance of water in the small depressions containing diatoms, desmids and other fresh water algæ. This water is fairly rich in bacteria. Of the several plates poured, we found the following number of bacteria per cubic centimeter:

BACTERIOLOGICAL ANALYSES OF WATER.

Story County. Pond.....	Agar.	Gelatin.	Colon Bacillus.
	2000	2800	Present
	2400		
	2800		
Pond near Eagle Grove Iowa.....	Agar.	Gelatin.	Litmus Lactose Agar.
	3640	60	2400
	3500		3000

Other ponds, rivers and spring waters in the state contained bacteria per c. c. as follows:

Spring Water.—The number of bacterial organisms found in spring water differs greatly. Mr. Buchanan has called attention to *Spirogyra* *Cladophora* and various diatoms found in spring water. It may be of interest here to add the number of organisms found in spring water from different parts of the state under different conditions. Open springs running through low marshes contain more bacterial organisms than the protected springs, or those that are cased in.

Algæ were relatively few in number in the limestone region of Allamakee county. Some of these springs contained large volumes of water,—sufficient to make a good-sized stream.

Living Goose Spring, Allamakee County.	Media.	Agar.	Gelatin.	Lit. Lac. Agar
		2400	1000	3700
		4800		
Smith Spring, Allamakee County.		2800		1800
				350

RIVER WATER SUPPLIES.

The number of organisms found in river water supplies varies greatly with the season. The following data may be of interest:

Fig. 33. Sandstone Region in Boone County, commonly called "The Ledges." Plants arranged. The *Cladonia* in dry open places. *H. goodii obtusa*, *Polypodium vulgare*, *Campylosorus phetophyllus*. Moist sandy rocks. The *Adiantum pedatum* in moist woods, with *Cornus circinata* and *Viburnum pubescens*.



Skunk River.		Number Bacteria per c. c. on Agar.					
	3200	5000	10320	3080	10030	19200	
	3240	2040	6200	1560		9080	
	11410	16590	12040				
	10220		6650				
Iowa River.		Agar.	Lit. Lac. Agar				
	3500		300				
Mississippi River.		Agar.	Lit. Lac. Agar.	Gelatin.			
	18906		5600				
	8400						
	8900						
	18000		5600	709			
Des Moines River.		Hour.	Temp.	Bacteria per c. c., No. 1.		Same, No. 2	
	10 a.m.	0°C.		40			
	11 a.m.	0°C.		1000		2750	
	12 m.	0°C.		500		1800	
	1 p.m.	1°C.		250		1000	
	2 p.m.	1°C.		600		
	3 p.m.	1°C.		250		500	

THE CARBONIFEROUS SANDSTONE IN BOONE COUNTY.

THE LEDGES.

These rocks have been formed under conditions similar to those of Hardin county. The flora is similar in some respects, but several important species have dropped out. There are no springs at present anywhere along Pease Creek, except in the prairie, though at the base of the rocks at Katina Falls a few small springs of good water occur. Pease Creek carries water during the entire year. This water comes largely from the meadows above the timber belt. The following plant formations occur in this region:

1. Sandstone formation, consisting of the
 - a. Exposed dry rock.
 - b. Moist talus and ledges.
2. The sandy, loamy, treeless slope. This again may be (a) dry or (b) moist.
3. The tree-covered slopes divided again into (a) moist exposures and (b) dry exposures.
4. Sandy bottoms along Pease Creek, (a) Mesophytic; (b) Hydrophytic.
5. Des Moines alluvium, (a) Forest, (b) Swamps.
6. Marshes above the coal measure shales.

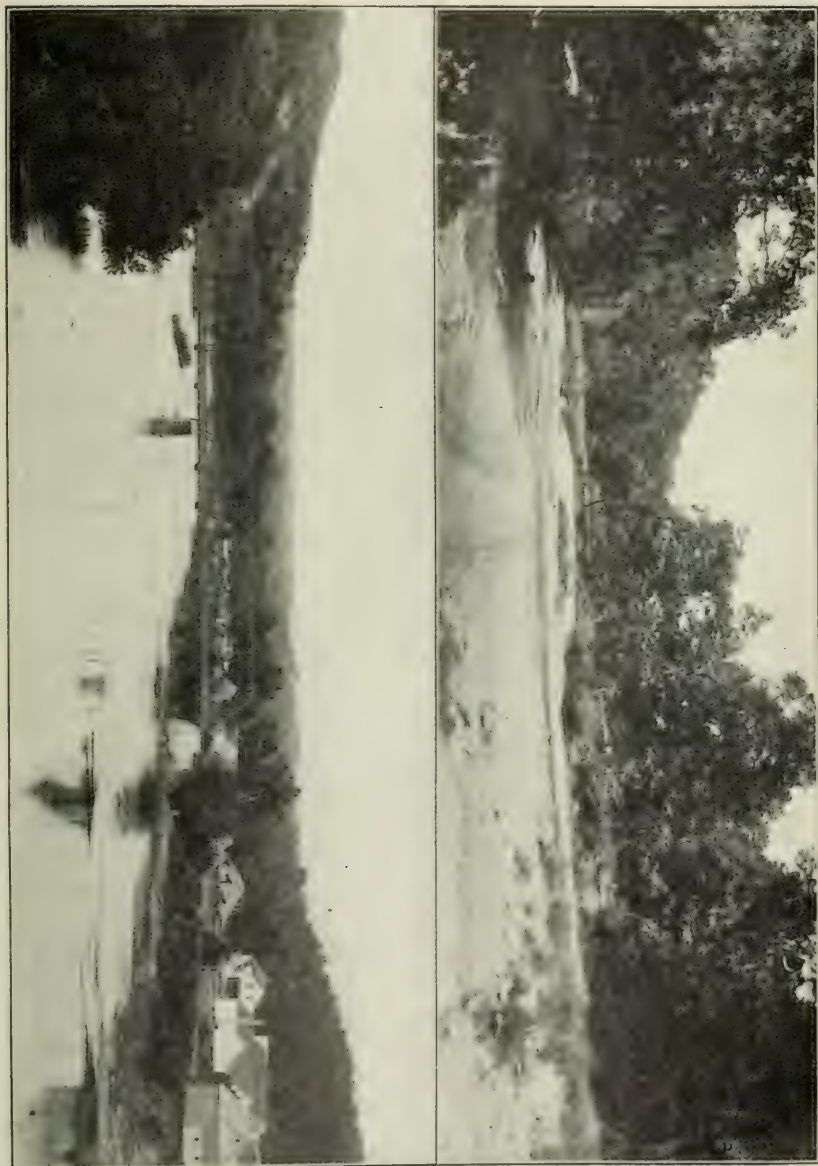


FIG. 34. The topography of the region about the Jeddys, Boone county, Iowa. Lower picture shows Moingona Bridge (Kate Shelley Bridge); the upper, alluvial region of the Des Moines near the Jeddys. *Acer saccharinum*, *Tinus americana*, *Larix laricina*.

1. *Sandstone Ledges*.—The Sandstone exposed dry rock contains some lichens, *Eatonia obtusata*, *Capsella bursa-pastoris*, *Taraxacum officinale*, *Erigeron canadensis*, *Chenopodium hybridum* and *Pilea pumila*. Many of the plants occurring here are annuals and make their growth in the spring. The moist rocks and talus contain *Aralia racemosa*, *Aralia nudicaulis*, *Camptosorus rhizophyllus*, *Cornus circinata*, *C. alternifolia*, *Galium aparine*, *G. boreale*, *Phryma leptostachya*, *Rudbeckia hirta*, *Woodsia obtusa*, *Cystopteris fragilis*, *Conocephalus*, sp., *Fragaria vesca*, *Polypodium vulgare*, *Mitella diphylla*, *Actaea spicata* var. *rubra*, *Prenanthes alba*, *Amphicarpæa monoica*, *Thalictrum dioicum* and *Teucrium canadense*.

Where sufficient age has been attained the rocks are covered with a mantle of clay and humus now overgrown with a good growth of young oak, (*Quercus rubra*), *Cornus circinata*, *Cornus alternifolia*, *Viburnum pubescens*, *Populus grandidentata*, *Acer nigrum*, *Juniperus virginiana*, *Rhamnus lanceolata*, *Quercus alba*, *Q. muhlenbergii* and *Amelanchier canadensis*. Of the herbaceous plants, *Thalictrum dioicum*, *Lathyrus venosus*, *L. ochroleucus*, *Cypripedium pubescens*, *Asarum canadense*, *Trillium nivale*, *Aralia nudicaulis*, *A. racemosa*, *Monarda fistulosa*, *Agrimonia eupatoria*, *Eupatorium ageratioides*.

The open spaces are covered with *Cladonia sylvatica*, *Polytrichum juniperium*, *Helianthemum canadense*, *Lechea major*, *Danthonia spicata*, *Eatonia obtusata*, *Koeleria cristata*, *Euphorbia corollata*, *Petalostemon candidus* and *P. violaceus*.

The ferns are particularly noteworthy here. The walking leaf fern is found only in a few scattered places either upon the talus or upon the damp vertical cliffs. It is associated particularly with *Polypodium vulgare*, *Woodsia obtusata*, several species of moss, occasionally with *Mitella diphylla*, *Thalictrum dioicum* and lichens.

2. The sandy, loamy, treeless area occupies but limited portions of the region. In the more dry and exposed places the reindeer lichens, *Cladonia sylvatica*, and a variety occur, as well as *Agrostis scabra*, *Danthonia spicata*, *Polygala senega*, *Comandra umbellata*, *Polygala verticillata* and *P. sanguinea*, with a few Leguminosæ like *Amorpha canescens*, *Petalostemon violaceus*, *P. candidus*, and the Evening Primrose (*Oenothera biennis*), which is

more or less weedy, and such composites as *Taraxacum officinale*, *Aster multiflorus*, *Solidago rigida* and *S. nemoralis*, also *Lechea major* and *Helianthemum canadense* are the more important plants of the drier situations. In the more moist situations *Cladonia sylvatica* grows to greater perfection, frequently surrounded with an abundant growth of *Polytrichum commune* and another moss, *Funaria flavicans*. Among the earlier spring flowering plants we note the *Anemone nemorosa*, *Polygala senega*, *Aralia nudicaulis* and *Antennaria plantaginifolia*, forming large masses. Among the later plants *Hieracium canadense*, *Aster laevis* and *A. azureus* are found.

3. *Tree-covered Slope*.—The greater part of the tree-covered slope consists of trees common in central Iowa. At one time it was thickly covered with timber. However, the beginning of a young forest has speedily taken the place of the old.

(a). Some of the plants found here are *Arabis laevigata*, *Aralia racemosa*, *Botrychium virginianum*, *Cornus alternifolia*, *Cornus circinata*, *Cystopteris fragilis*, *Desmodium nudiflorum*, *Galium aparine*, *G. boreale*, *Heliopsis scabra*, *Phryma leptostachya*, *Silene stellata*, *S. nivea*, *Viola palmata*, *V. cucullata*, *V. pubescens*, *Adiantum pedatum*, *Carpinus caroliniana*, *Ostrya virginica*, *Monarda fistulosa*, *Populus grandidentata*, *Lathyrus ochroleucus*, a very rare plant in central Iowa, *Quercus alba*, *Q. rubra*, *Carya amara*, *C. alba*, *Juniperus virginiana*, which more properly belongs to the dry talus, but there are scattered trees and shrubs throughout the woods, like *Rhamnus cathartica*, *Viburnum pubescens*, *Corylus americana*, and *Prunus pennsylvanica*.

(b). *Quercus muhlenbergii*, *Rhus glabra*, *Cornus candidissima*, *Bromus purgans*, *Arabis laevigata*, and a host of plants that are common to both regions, as the following: *Amelanchier canadensis*, *Cornus paniculata*, *Desmodium nudiflorum*, *Hydrophyllum appendiculatum*, *Populus grandidentata*, *Acer nigrum*, *Solidago ulmifolia* and *Asprella hystrix*.

4. *Sandy Bottoms*.—The fourth division contains many plants common to the upland, such as *Impatiens pallida*, *Astragalus canadensis*, *Oenothera biennis*, *Iraxinus pubescens*, *Agrostis perennans*, *A. alba*, *Poa pratensis*, *Laportea canadensis*, *Carex straminea*, *C. pennsylvanica*, *Panicum lanuginosum*, *Melilotus alba*, *Lithospermum latifolium*, *Cicuta maculata*, *Ulmus racemosa*, *Acer nigrum*, *Strophostyles angulosa* and *Lippia lanceolata*.

Of the hydrophytic plants few remain. *Spirogyra*, *Zygnema*, *Cardamine rhomboidea*, *C. hirsuta* and *Caltha palustris* are the more important plants occurring in the brook. The water in Pease Creek flows rather rapidly, so that few plants of this type obtain a foothold. They are, however, found attached to sticks or occur on the shores.

5. *Des Moines Alluvium*.—The character of the vegetation of the alluvial bottom of the Des Moines River is not essentially different from that in other sections in central Iowa. We have



FIG. 35. "Marshes of the prairie region of central Iowa. *Scripus lacustris*, *Sagittaria*, *Ranunculus multifidus* and *Iris versicolor*. Story county, Iowa. Photo. by C. M. King.

the soft maple (*Acer saccharinum*), *Negundo aceroides*, *Ulmus americana*, *Fraxinus viridis*, *Populus monolifera*, *Salix amygdaloides*, *S. longifolia* and *S. nigra* as the most important of the trees and shrubs. Under the shade of these trees or on the margin of the woods we find the following herbaceous plants: *Leersia virginica*, *Elymus virginicus*, *Panicum crus-galli*, *Pilea pumila*, *Bidens frondosa*, *Vernonia fasciculata*, *Aster tradescanti*, *Nasturtium palustre*, *Cinna arundinacea*, and *Spartina cynosuroides*. It

is remarkable that the Sycamore, *Platanus occidentalis*, does not occur along the banks of the Des Moines in the vicinity of the Ledges (at least the writer has never seen it) while it is abundant at Ames, on the Skunk River, and Squaw Creek and also at Des Moines along the Des Moines and lower Coon. Dr. Beyer has shown that the Des Moines River during the post-glacial times had its course further eastward, flowing into what is now Skunk River just north of Ames. It is equally remarkable that the Buckeye, *Asculus glabra*, does not occur on the Skunk River just north of Ames, nor for that matter in the country along the Skunk River, though common further southward. On the other hand *Asculus glabra* is not infrequent along the Des Moines as far north as Frazer in Boone county. However, this species is found on the hills. What causes have operated to bring about this somewhat anomalous distribution can not be answered until a more extended investigation can be made of the causes that underlie the northward and southward extension of species.

(b) The swamps are adjacent to the Des Moines River. These swamps are not conspicuous in the vicinity of the Ledges as the banks rise rather abruptly. But where they are developed they appear at one time to have been bayous of the river. During times of high water they were filled and contained a large number of aquatic plants. These bayous have gradually been filled by the accumulation of sedimentary material so that near the mouth of small streams they have become flattened areas. During the spring of the year they are quite moist, since the drainage is not perfect. In the little depressions that are formed we find the more conspicuous plants to be *Iris versicolor*, *Typha latifolia*, *Lobelia syphilitica*, *Carex trichocarpa* var. *aristata*, and further on the drier uplands of the banks, *Carex stricta* and *Salix discolor*. Where drainage has been more perfect and the accumulation of a greater amount of sedimentary material has occurred, a high second bottom is frequently formed. These are not marshes in any sense of the word, but have been developed from the marshes just mentioned. In these alluvial upland bottoms the *Acer nigrum*, *Ulmus fulva*, *Celtis occidentalis*, with *Phlox divaricata* and *Asarum canadensis* form the more conspicuous plants.

6. The marshes above the coal measures, shales, carry moisture during the entire year. Here we find perennial springs.

Where there is much moisture they are treeless. A single typical area in the vicinity of High Bridge may be taken as a type. This area covers about two acres in extent and is typical of the numerous other small marshes found in the vicinity, and typical also for other marshes in central Iowa. The only shrubs occurring in the vicinity of the springs are the *Salix discolor* and *S.*



FIG. 36. Shooting Star (*Dodecatheon media*). On open prairie near Jewell Junction, Iowa. *rostrata*. The banks surrounding the spring are covered with *Cardamine rhomboidea*, *Caltha palustris*, followed by *Cardamine hirsuta*, *Viola cucullata*, *Glyceria nervata*, *Lathyrus venosus*, *Thalictrum purpurascens*, *Calamagrostis canadensis*, *Eupatorium purpu-*

reum, *E. perfoliatum*, *Chelone glabra*, *Aster umbellatus*, *Gentiana crinita*, *Cypripedium candidum*, *Aster salicifolius*, *Solidago serotina* and *S. ohioensis*.

7. *The Prairie Vegetation.*—The plants of this area are similar to the plants found in many other sections in central Iowa, especially that affected by the Wisconsin drift. The morainic flora consists of plants that are usually adapted to drier conditions. The *Anemone patens* var. *nuttalliana*, *A. caroliniana*, and *Draba caroliniana*, are rare plants. The more common plants of



FIG. 37. A bit of prairie with *Dodecatheon media*, near Jewell Junction, Iowa.

this drift material are *Viola pedata* and *V. pedatifida*, *Castilleja sessiliflora*, *Lithospermum angustifolium*, *L. canescens*, *Polytænia nuttallii*, *Ceanothus ovalis*, *Oenothera serrulata*, *Stipa spartea*, *Baptisia leucophæa* and *Rudbeckia hirta*.

The flora of the lower and flat areas consists of *Anemone pennsylvanica*, *Thalictrum purpurascens*, *Juncus tenuis*, *Panicum scribnerianum*, *P. virgatum*, *Liatris scariosa*, *L. pycnostachya*, *Vicia americana*, *Baptisia leucantha*, *Lilium philadelphicum*, *L. canadense*, *Spiranthes cernua*, *Lathyrus venosus* and *Cicuta maculata*.

In these ponds, which may become dry, the floating *Utricularia vulgaris* is common; *Carex trichocarpa* var. *aristata*, *C. crus-corvi*, *Scirpus atrovirens*, *Ranunculus multifidus*, *Iris versicolor* and *Phalaris arundinacea* occur; *Phragmites communis* and *Scirpus lacustris* are common.



Fig. 38. *Sagittaria variabilis* and *Scirpus lacustris*. Many algae are found in such ponds in the spring. These ponds may become partially dry towards the close of the season. Photograph by Charlotte M. King.

The Cordova Sandstone Ledges.—The Cordova sandstone ledges are somewhat similar to those of Boone and Hardin counties. They occur in Marion county, some distance southeast from Des Moines, along the Des Moines River. The boreal plant types

have largely disappeared. The ferns consist chiefly of *Cystopteris fragilis* and *Adiantum pedatum*.

The trees found here are those common to central Iowa with the exception of the common occurrence of the Buckeye (*Esculus glabra*) and *Cercis canadensis*, which occur at the base of the bluffs. The Redbud, while not present in the immediate vicinity of the ledges, does occur near Des Moines. The *Delphinium tri-corne* grows in the rich soil at the base of the bluffs among the broken fragments of the sandstone rock. We note upon the tops of the bluffs two southern representatives, the *Poa trivialis* and

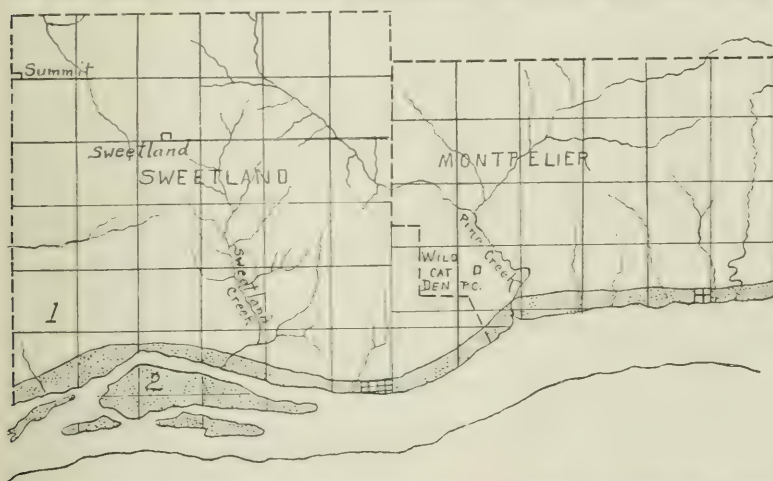


FIG. 37. Map of the Pine Creek region, Muscatine county, Iowa. 1—Iowan loess; 2—Alluvium. The White Pine, *Gaylussacia*, *Phlegopteris hexagonoptera* and *Aspidium longichitis*, found in the Pine Creek region. After Iowa Geological Survey.

Myosotis verna. *Cerastium nutans* and *Cynthia virginica* are also common, though absent in Hardin and Boone counties. The *Poa trivialis* is generally considered native of northern Europe but it is undoubtedly indigenous to this country. If we compare these regions with the Pine Creek region of Muscatine county, farther southeast on the Mississippi, we find the following very interesting facts.

Pine Creek Region of Muscatine County.—The Pine Creek region of Muscatine County contains among other plants the following: *Circaea alpina*, *Aspidium acrostichoides*, *Gaylussacia resinosa*, *Panicum glabrum*, *Aspidium cristatum*, *Camptosorus rhizophyllus*, *Asplenium thelypteroides*, *Adiantum pedatum*, *Pteris aquilina*, *Polypo-*

dium vulgare, *Lycopodium lucidulum*, *Osmunda claytoniana*, *O. cinnamomea* and *O. regalis*.

The White Pine in Muscatine county is the most southern extension of the species in the state of Iowa. On the slope of the hills other trees common to the state, like *Juglans cinerea*, *Quercus alba* and *Q. rubra*, occur.

Lespedeza violacea and *L. reticulata* occur in drier soil. *Cercis canadensis*, *Cerastium nutans*, *Arenaria latifolia*, *Goodyera pubescens*, *Fragaria vesca*, *Convolvulus spithameus*, *Agrimonia parviflora*, *Spirea aruncus*, *Rubus cuneifolius*, *Aster cordifolius*, *A. corymbosus*, *A. macrophyllus*, *Chelone glabra*, *Gerardia tenuifolia* var. *asperula*, *Maianthemum canadense*, *Camassia fraseri* are other species of the region.

Of the rarer plants occurring in this vicinity, but not on these sandstone bluffs, mention may be made of *Rhexia virginica*, *Phlox bifida* along the Cedar River; *Symplocarpus foetidus*, *Allium tricoccum*, *Calopogon pulchellus* in boggy places in the Cedar River region; *Dodecatheon meadia* is rather common on prairies; *Angelica atropurpurea* in low lands. *Cicuta bulbifera*, *Pentstemon grandiflorus*, *Breweria pickeringii*, *Cristatella jamesii*, *Helianthus petiolaris* and *Panicum autumnale* is more or less common on Muscatine Island.

Mr. R. E. Buchanan has contributed the following on the Algal Flora of the region. The algæ were listed by Dr. Bessey.¹

NOTES ON THE ALGAL FLORA OF THE REGION.

BY R. E. BUCHANAN.

No collections were made of the algæ from southwestern Wisconsin, but the following method furnished us with the names of a few of the algæ that are abundant in that locality. Three types of the soil of that locality were placed in separate sterile jars and covered with water. Each of the jars soon developed an abundant growth of the algæ.

The peat soil naturally was by far the most productive of forms. The relative abundance of the organisms as they occur in the peat naturally and in the aquarium was certainly different,

1. Bull. Ia. Agr. Coll., Bot. Dept., 1884: 139.

but all those that were found are fitted just as certainly for life in the peat bogs of that country. The list of forms is as follows:

<i>Oscillaria tenuis.</i>	<i>Ulothrix zonata.</i>
<i>Oscillaria natans.</i>	<i>Chætophora elegans.</i>
<i>Anabaena flos aquæ.</i>	<i>Gonium pectorale.</i>
<i>Scenedesmus dimorphus.</i>	<i>Gomphonema constrictum.</i>
<i>Scenedesmus obtusus.</i>	<i>Cymbella cuspidata.</i>
<i>Tetraspora lubrica.</i>	<i>Synedra</i> sp.
<i>Protococcus viridis.</i>	

The other two soils examined in this manner were a yellow clay and a yellow loam. The same organisms developed in both of

these jars. Neither of these soils was, of course, naturally under water. The algæ therefore are of a character to take advantage of any increase in moisture, to make a rapid growth, and to resist desiccation. The list of organisms is as follows:

Oscillaria violacea.—

Forms a dense mat over the surface of the clay. Bubbles form underneath and it is forced up until it floats.

Nostoc muscorum.

Oscillaria tenerrima.

Stauroneis sp. Very minute.

The only collection of algæ from northeastern Iowa that was examined was one that came from the effluent of one of the large springs that issue from the limestone rocks of that region. It con-

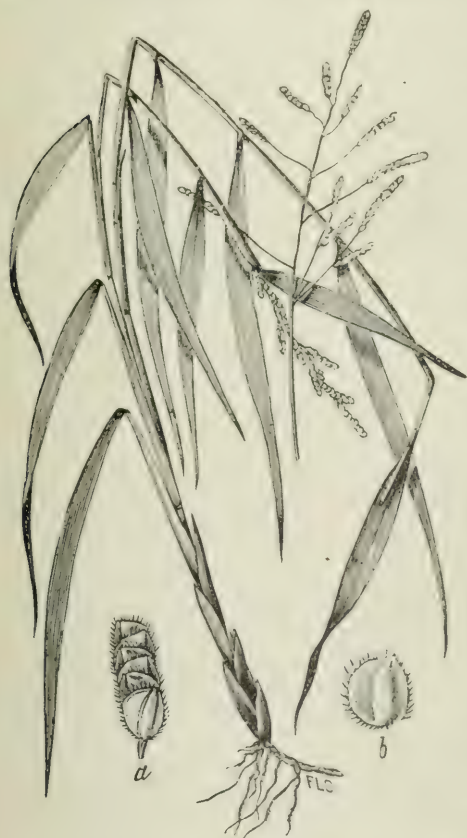


FIG. 40. *Leersia lenticularia* in low grounds along the Mississippi. (U. S. Dept. Agrl.)

sisted of a dense mat of *Vaucheria sessilis* in fine fruit. The collections that have been made in the vicinity of the Ledges in central Iowa have been more numerous. Here are to be found a number of springs, ledges of limestone and sandstone rock, creeks and the Des Moines River. The algal flora is therefore very varied and mention can be made of a few only of the many forms.

The water that issues from the springs of this region supports a very characteristic flora. The shallow, cold, clear water seems to be a favorite locality for the *Vaucheria*. These are of the two species, the *V. sessilis* and the *V. geminata racemosa*. These mats, sometimes several feet in diameter and an inch thick, are the home of a large number of diatoms. Wherever the water trickles in fine streams along the surface of the rocks will be found the *Nostoc muscorum* and the *Scytonema*. These, with the

Pleurococcus, form the gonidia of the hundred or more lichens that are to be found in this locality. In one little pool exposed to the full rays of the sun and quite warm, the *Rhaphidium polymorphum* was so abundant that the whole mass of the water was of a dark green.

The rocky streams that cut through these ledges of rock have as their most conspicuous alga the *Tetraspora cylindrica*. At times during the summer the stones in the bed are covered with long streamers of this alga. These sometimes reach to a length of several feet. Diatoms of many species are here to be



FIG. 41. *Vaucheria chapmaniana* in fields and flood plains of southeastern Iowa. (U. S. Dept. Agr.)

found also. In the quiet pools may be found masses of the *Spirogyras*, such as *S. crassa* and *S. fluvialis*, together with *Closterium lanceolatum* and *Zygnema stellium*.

The Des Moines River at this point is deep and muddy, offering a very poor chance for any considerable growth of the algae. In some of the quieter bayous and the shallows, however, a few forms may be found. Among these are the following:

<i>Merismopedia glauca.</i>	<i>Spirogyra deciminata.</i>
<i>Nostoc commune.</i>	" <i>maiuscula.</i>
<i>Anabaena flos-aquæ.</i>	" <i>varians.</i>
<i>Cylindrospermum macrospermum.</i>	" <i>dubia.</i>
<i>Oscillaria tenuis.</i>	<i>Vaucheria sessilis.</i>
<i>Oscillaria viridis.</i>	<i>Microspora abbreviata.</i>
<i>Tetraspora lubrica.</i>	<i>Ulothrix subtilis.</i>
<i>Characium naegeli.</i>	<i>Stigeodinium tenua.</i>
<i>Tetrædon longispinum.</i>	<i>Cladophora fracta.</i>
<i>Closterium acerosum.</i>	<i>Euglena viridis.</i>
<i>Zygnema stellium.</i>	<i>Edogonium capillare.</i>

The above is not the result of any single collection, but of several collections at different times. Further collecting would probably considerably extend the list.

SOME LOCAL PROBLEMS IN THE GEOGRAPHICAL DISTRIBUTION OF THE WISCONSIN AND IOWA FLORA.

Several interesting problems on the geographical distribution of plants in the areas under consideration may now be discussed. Mr. C. C. Adams has shown that southeastern United States is a center of the geographical distribution of a part of our flora.¹

Dr. John W. Harshberger, in his recent phytographic sketch of eastern and southeastern Pennsylvania, states as follows: "With the retreat of the great ice-sheet, the region once covered by the ice was restocked by trees and herbs derived from three main sources of supply: (1) Scandinavia, (2) Hudsonian zone of the Glacial period, (3) Appalachian forests (north and south). The Scandinavian plants migrated eastward during the interglacial period and tenanted the moraines, nunataks and arctic strip of territory throughout the later glacial epoch. With the retreat

1. Biological Bull., 3: 123.

of the glaciers, they migrated northward with the ice sheet, or they persisted on the tops of high mountains which existed as nunataks during the ice age, or they remained as boreal islands in sphagnum bogs, or in cold and shaded ravines. A northward migration of Hudsonian species and of Appalachian species in concentric waves also took place at the close of the Glacial period.¹

The action of the several uplifts and depressions of the earth's surface described was most profound upon this forest, the history of which has been traced. With every submergence of the lower portions of the creeks of the region and of the Delaware river, the forest in the area of submergence was destroyed, or if existing on the higher grounds, was subjected to such extensive changes of level as to modify its character and the distribution of the component species. Many species were crowded together by the change of level and the wearing away of the strata to which they had become adapted, for "if we suppose the earlier Mesozoic uplands to be the seat of the existing dicotyledons, then by the lowering of the surface by gradual consumption of the interstream areas, these forms must have been brought into conflict with the flora of the lowlands and thereby forced into a contest for supremacy."²

Dr. Livingston, in a discussion of the forests of Roscommon and Crawford counties, says: "The hardwood forest reappears quite rapidly when cut. This is doubtless in part due to the fact that this material does not burn so readily nor so violently as do the pines. The scattered white pines which formerly characterized some of these forests in the eyes of the lumberman are not returning. They are perhaps only a relic of a past generation of forest. Hemlock is reproducing well and will return with the beech and maple if, through lack of humus, the soil does not become too dry for the seedlings. Its seedlings stand close together and do not seem to suffer from one another's shade."³

It seems to me that the floras found at several different points, of the region here considered, especially the coinfers, are relics of a flora once abundant in this region.

1. Cf. Adams, C. C. Post-Glacial Origin and Migration of the Life of the Northeastern United States. Jour. Geol., 1903: 303.

2. Woodworth, J. B. The Relation Between Baseleveling and Organic Evolution. Am. Geol., 14: 231. 1894.

3. Bot. Gazette, 39: 38.

A few of our bog plants, *Pyrus arbutifolia*, *Nemopanthes fascicularis*, and *Rhynchospora alba* are southern and have migrated northward from the southern Appalachians, as suggested at least for the *Pyrus* by Transeau. The *Vaccinium corymbosum*, *V. atrococcum*, *Rhodora canadensis* and *Viburnum cassinoides* have not extended to our region. The *Gaylussacia resinosa*, though occurring in swamps, is not found in any of the bogs that I have studied, in either Wisconsin or Iowa. It does, however, occur in rocky woodlands of Muscatine county. It must be added to the immigrants from the southeast. One of the most striking immigrants from the southeast is *Rhexia virginica*, which occurs in the sandy swamps of the Cedar River near Muscatine. Nowhere in the region do the southern forms reach an optimum of development; they are crowded out by other dominant types; the same is true of the boreal types found here. The *Linnæa borealis*, *Vaccinium macrocarpon*, *Calopogon pulchellus*, *Pogonia ophioglossoides*, *Sarracenia purpurea*, *Drosera rotundifolia*, *Gentiana crinita* and *Campanula aparinoides* are some of the more important immigrants from the north.

These plants are, however, very local. Of wider distribution in swamps, the *Cnicus muticus*, *Menyanthes trifoliata*, *Valeriana edulis*, *Saxifraga pennsylvanica*, *Lobelia kalmii*, *Viola blanda* and *V. lanceolata*, reach over into Iowa. *Ledum latifolium* does not occur in our region, but near Kilbourne City, on the sandy rocks of the Dalles of the Wisconsin, it is found with *Thuya occidentalis*, *Pyrus americana* and *Aspidium fragrans*. The *Betula pumila* is quite common in the swamps of western Wisconsin, especially tamarack, but it scarcely reaches into Iowa. The *Salix candida* is common in similar places, and reaches over into Worth, Cerro Gordo and Winnebago counties, and south to Johnson county. There are, however, few stations south of Cerro Gordo county. The *Salix lucida* is common in tamarack swamps and extends down to Buchanan county, Iowa, two localities being given by Ball in his paper on "The Genus *Salix* in Iowa." The *S. rostrata*, though a tree, is generally of small stature in western Wisconsin and southeastern Minnesota. It is commonly found where the Wisconsin drift occurs and southeast to Johnson county, according to Ball. The *S. discolor* and the boreal willow are much more common in the swamps of northern

Iowa which occur from Dickinson, Boone, Monroe and Henry counties in the southeastern part of the state.

The *Taxus canadensis* is common in Wisconsin and extends south into Iowa as far as Linn county. The White Pine is most interesting in its distribution. It occurs in isolated areas as far south as Montpelier township in Muscatine county, the most southern point in Iowa. The groves in northeastern Iowa are larger and more frequent. In Hardin county there is one small area isolated from the areas in eastern Iowa. It is, however, more than probable that the species once had a much wider distribution.

There are well-preserved conifers in drift material from various parts of Iowa. Through the kindness of Mr. Savage I have been permitted to examine some wood in a fairly good state of preservation found in the southwestern part of the state. The wood appeared to be Red Cedar and Hemlock (*Tsuga canadensis*). Well-preserved wood has also been found in wells at a depth of 60 feet in northeastern Iowa. One piece was 14 inches long. According to Mr. Orr, these were probably conifers. They occur between the Iowan and Kansan drift. It is more than probable that coniferous forests once covered the entire state. Indeed Dr. Bessey thinks that in recent geological times coniferous forests were common in Nebraska.¹ The *Abies balsamea* is also a boreal species and occurs in an isolated area. The only point at which it occurs is in northeastern Iowa. It does not occur in western Wisconsin nor southeastern Minnesota. The *Larix americana* is more abundant, but is an exclusive swamp species. Of the four common trees found in swamps, the Black Spruce, Arbor Vitæ, Balsam and Tamarack, the latter is not uncommon in western Wisconsin. The balsam is found in northeastern Iowa, while the others are wanting in the area under consideration. The genus *Betula* is interesting from the standpoint of distribution. The *Betula papyrifera*² is common in western Wisconsin and northeastern Iowa. It is rare south of Dubuque on the Mississippi. Hardin county is the western limit in Iowa. *Betula lenta* occurs in western Wisconsin on sandy rocks, and in southeastern

1. Annual Report, Neb. St. Bd. of Agr., 1888: 93.

2. *Betula alba*.—Contr. Gray Herb., Harv. Uni., new ser., 23: 169. Amer. Jour. Sci., 14: 169: 1902.

Minnesota. It drops down into southeastern Minnesota, but is a rare tree. It is fairly common in one place in Hardin county, along the Iowa river at the base of sandstone ledges. The *Betula pumila* has been referred to as common in swamps in western Wisconsin.

It does not seem probable that the *B. lenta* was scattered by the northeast winds from northeastern Iowa, for at the time when the seeds are ripe the winds are usually west and southwest. The same may be said of the *Betula lenta*, which is not uncommon on the sandy rocks of the rivers of western Wisconsin in the latitude of La Crosse and in isolated places in western and southeastern Minnesota. The wind has played scarcely any part in its distribution in central Iowa. River Birch (*B. nigra*) no doubt owes its northern extension to its wind-dissemination. Its distribution may also have been aided somewhat by the water. Three conifers may briefly be mentioned as wind-disseminated. They are *Pinus strobus*, *P. resinosa* and *P. banksiana*.

P. banksiana is common only upon the pine barrens of the La Crosse River and northward and eastward. *P. resinosa* is found in a few outlying stations along the Black River, between Galesville and La Crosse, and is not uncommon on the east branch of the Kickapoo near Rockton. The White Pine and the *Larix americana*, as mentioned elsewhere, are more widely distributed.

The white pine in Hardin county was scarcely brought by the wind in recent times from northeastern Iowa. There are evidences of wind-dissemination of the larch and white pine for six or seven miles and the larch probably has been carried twelve miles. Generally speaking, the wind-disseminated plants are scarcely scattered as far and wide as those by birds.

Of the genus *Prunus*, the *P. pennsylvanica* is common in northeastern Iowa, Wisconsin and Minnesota. It is quite common in Hardin county, but rare in Story county, except in a few localities. In Boone county it is found on the sandstone ledges. The *P. scrotina* is generally distributed in eastern Iowa, reaching out to central Iowa. The *Juglans nigra* is found everywhere on the larger streams like the Des Moines, Iowa, Cedar and Skunk rivers. The *Platanus occidentalis* is another southern species which has made its way northward along all the larger streams, nearly reaching the Minnesota line.

The *Carya sulcata*, so common southward, is found on Muscatine Island and in southeastern Iowa. The *C. tomentosa* is of somewhat wider distribution, but does not reach much further north than Muscatine. The Pecan is found as far north as Sabula.

The *Gymnocladus canadensis* reaches to the Minnesota valley. The *Morus rubra* is found in Houston county, Minnesota. In Iowa it is local but occurs in woods along the larger streams, at Des Moines, Boone, Ames and Missouri Valley. The water courses have been important factors in the distribution of our trees and shrubs. Of the trees disseminated by birds, the *Celtis occidentalis*, a species of *Cornus*, the *C. paniculata*, *C. candidissima*, *Vitis riparia*, *Rhus toxicodendron*, *R. glabra*, *Amelanchier canadensis* and *Rosa blanda* are of wide distribution. The *Symphoricarpos vulgaris* and *S. occidentalis*, *Cornus stolonifera*, *Vitis cinerea*, *Rhus venenata*, *Morus rubra*, *Vaccinium macrocarpon*, *V. pennsylvanicum*, *Gaultheria procumbens*, *Arctostaphylos uva-ursi* and *Viburnum opulus* are annual, of somewhat local distribution; very local indeed are the cranberry, blueberry, bearberry and poison oak (*Rhus toxicodendron*), *Vitis cinerea* and the two species of *Symphoricarpos*, one, the *S. vulgaris*, is southern, while the other is northern, quite as common in the Rockies as in Minnesota and Wisconsin. In Wisconsin and southeastern Minnesota it is found upon the bluffs. In Iowa it is abundant upon the loess soil upon the Missouri and the borders of the lakes in northern Iowa.

The seeds of this have no doubt been widely scattered by birds, but it was only when conditions were favorable that growth occurred. Now, if we take into account wind-disseminated shrubs and trees, the conditions for wide scattering are less favorable. Most of our streams in the area are considered to flow in a southeasterly direction. This is true at least of the larger streams. The Mississippi River, although somewhat tortuous, is, however, an important exception. Our winds are either from the north, south, east or west, and it is rather exceptional to have the winds blow any great length of time from the southeast or northwest, hence the chances for scattering of seeds for great distances along the streams are less favorable, except on the Mississippi. Of the wind-disseminated trees the more important are the willows, the *Salix cordata*, *S. amygdaloides* and the shrubby willows, which

are generally common along the streams. The cottonwood, *Populus monilifera*, is found in all parts of the state, except the very small tributaries. By nature the tree prefers alluvial soil. However, since the settlement of the state, the species has become more or less widely scattered in railroad cuts, gravel beds and stone quarries.



FIG. 42. Common Polypody (*Polypodium vulgare*). Sandy rocks and ledges of Boone county, Iowa. Photograph by Charlotte M. King.

Other animals have aided in the dissemination of some of our trees and shrubs. There can be no doubt that the genera *Quercus*, *Juglans* and *Carya* are largely disseminated by squirrels, and in former times larger animals no doubt also helped to disseminate *Rubus strigosus*, *Amelanchier canadensis*, *Arctostaphylos* and *Vaccinium*. These plants show the same northbound and southbound movements that the bird- and wind-disseminated plants do.

The other species of *Populus*, the seeds of which are scattered by the wind, may be mentioned, viz., the *Populus tremuloides* and *P. grandidentata*, the former more abundant in northeastern Iowa, Wisconsin and Minnesota than in central Iowa. It is the only species native around the swamps in Cerro Gordo and Worth counties. The *P. grandidentata* is abundant everywhere in Wisconsin, Minnesota and northeastern Iowa, and reaches over into Hardin and Boone counties, common only upon the carboniferous sandstone in central Iowa, while in Wisconsin and Minnesota it is common upon the St. Croix sandstone.

SOME COCCIDAE FROM THE PHILIPPINE ISLANDS.

BY T. D. A. COCKERELL.

So far as I am aware, only one Coccid has hitherto been recorded from the Philippine Islands, namely, *Chrysomphalus rossi*, from Manila (Proc. Acad. Nat. Sci. Phila., 1899, p. 274). The collection now reported on was obtained by Professor C. H. Tyler Townsend, who in former years discovered so many new Coccidæ in Mexico. Being quite familiar with the group, he knew what to look for, and as I expected, the results are highly satisfactory. While the number of new species is considerable, there are no new genera; but practically everything came from cultivated plants, and it may well be that an examination of the recesses of the native forests will yield more highly characteristic endemic forms.

Monophlebulus townsendi, n. sp.

♀ Grey, flattened, 9^{mm} long, 7½ broad, about 3 high, when dry; the true color is very dark reddish, the grey appearance resulting from the mealy covering; there is a well-defined dorsal area, about 4^{mm} broad, marked in the abdominal region by strong transverse ridges representing the segments; anal orifice plainly visible with a lens, on the dorsal surface about 2½^{mm} from hind end; it is small and round, about 168μ diameter, hairless.

Legs and antennæ black; legs very stout; middle of abdominal region deeply concave beneath, the sides (broad marginal area) densely covered with white cottony tomentum; mouth parts visible in the form of a projecting dark cone; anterior margin of body emarginate and from the emargination arise some long coarse blackish bristles. Antennæ about as long as femur and trochanter of middle leg, i. e. about 1½^{mm}; six joints, 3 to 6 about equal, each about 300μ long; 2 shorter and considerably stouter; first joint broader than long; the joints have coarse pale

yellowish bristles, very numerous on the last two. Eggs, raspberry color, about 765μ long.

Batangas, Sept. 20. Peculiar for the six-jointed antennæ in the adult. The only other known species of the genus is Australian.

Icerya candida, n. sp.

♀. With ovisac about 7^{mm} long (perhaps longer when quite perfect), ovisac not grooved; all the secretion pure white, densely covering the body; there are some white glassy filaments, but they are not numerous; antennæ dark red-brown, 11 jointed, about 900μ long; joint 4 shortest, being much broader than long; 11 long and slender and much the longest; 2 and 3 about equal and much longer than any of the joints between 3 and 11; 8 to 10 longer than broad; 1 very broad. Legs ordinary, dark reddish, anterior femora stout.

Young with six (three pairs) of extremely long caudal bristles, longer than the body; long lateral hairs not differentiated into two series, but about equally variable in length all round body; antennal club stout, with long bristles, one of them about as long as whole antenna. Apex of abdomen not emarginate.

Manila, June 4, on a cultivated tree with large oblong-ovate rough leaves. The adult has the last antennal joint obviously longer than the two before it combined and it is much longer than Douglas figures for *I. ægyptiacum*. The larva belongs to the *I. purchasi*—*seychellarum*—*ægyptiacum* group; the lateral hairs are very much longer than those shown in Douglas's figure of *ægyptiacum*.

Icerya seychellarum (Westwood).

Lucban, Tayabas, Luzon, March 30, 1904, on cultivated rose; Manila, June 1, on cultivated guava. A parasite was bred from the Manila specimens and sent to Dr. Ashmead, who will describe it as *Parasaphes townsendi*, n. sp.

Pseudococcus lilacinus, n. sp.

2. Globose, densely covered with white meal, when mounted subglobular, about 1800μ long; after boiling in caustic potash, the pigment in the body is lilac; legs fairly short, anterior leg with femur and trochanter 200μ long, tibia 100, tarsus 65; hind leg,

femur and trochanter 245, tibia 150, tarsus 70, width of femur 65μ ; claw stout, simple. Antennæ 8-jointed, length of joints in μ (1.) 25-55, (2.) 32-52, (3.) 37-50, (4.) 20-45, (5.) 25-42, (6.) 27-30, (7.) 30, (8.) 80. In one instance joint 3 measured 73, evidently being combined with 4. Larva in body of female about 375μ long. Lucban, Tayabas, April 10, 1904, on cultivated orange.

I supposed at first that this must be *P. filamentosus*, but that is quite different by the blue-green pigment after boiling and the antennæ are also different. On account of the pigment, it is equally excluded from *P. albizziae*. By the purplish pigment and general appearance it resembles *P. quaintancii* (Tinsley); it is also rather near *P. texensis* (Tinsley) and *P. comstocki* (Kuwana). The antennæ are very variable, but the series of measurements 25, 45, 45, 22, 25, 30, 30, 80, expresses what I take to be the more normal lengths of the joints.

Pseudococcus tayabanus, n. sp.

♀. Covered with mealy secretion, distinctly segmented, looking (when dry) like minute specimens of commercial cochineal; when mounted oval, about 1500μ long; after boiling, the body is seen to contain much dull crimson pigment, especially in the embryonic young; eyes well-developed; anal ring with six hairs, and placed in a wide squared incision; lateral margins of segments projecting, so that the margin is strongly undulated, the projecting points bear stout spines, about 12μ long; skin greatly crowded with round glands; labium long and narrow, about 150μ long and 70 broad; legs stout, length of tibia about 125μ (counting from middle to middle), tarsus 75; claw stout, simple; antennæ 8-jointed, joints measuring in μ (1.) 50, (2.) 50-62, (3.) 50-52, (4.) 25-27, (5.) 33-40, (6.) 40-45, (7.) 37-40, (8.) 87. The smaller measurements (50) for two appears to be normal.

Larva with longitudinal rows of bristles (not spines), the middle row double; six stout hairs on anal ring; claw long, simple; antennæ 6-jointed, joints measuring, (1.) 20, (2.) 22, (3.) 17, (4.) 17, (5.) 22, (6.) 52-55. Joint 8 bears three whorls of hairs, and ends in a stout blunt cone.

Lucban, Tayabas, April 7 and April 20, 1904, on cultivated cacao.

A peculiar species, in many respects like *P. texensis* (Tinsley). The antennæ are not unlike those of *P. comstocki* (Kuwana), but that has joints 4 and 5 not very different in length.

Pseudococcus virgatus (Cockerell), variety.

♀. Secretion full of glassy filaments; anterior leg with femur and trochanter 292μ long, tibia 212, tarsus 89; claw rather long, simple; antennæ 8-jointed, 8 with three whorls of hairs; joints measuring (1.) 50, (2.) 63-65, (3.) 70-72, (4.) 37-42, (5.) 40-45, (6.) 45-47, (7.) 45-47, (8.) 100.

Lucban, Tayabas, April 20, 1904, on cultivated croton.

Typical *virgatus*, from Jamaica and Ceylon, is larger, with the third antennal joint considerably longer. The antennæ of the Philippine insect practically agree with those of *P. kraunhiæ* (Kuwana), and I should not be surprised if the two proved identical, though Kuwana does not allude to any glassy filaments. Kuwana says that *kraunhiæ* has the tibia three times as long as the tarsus, but his figure contradicts this. Our insect also shows some resemblance to *P. magnolicida*. Whether or not it is identical with anything described, I think it is undoubtedly a variety of *P. virgatus*.

Saissetia nigra (Nietner).

Manila, May 19, on cassava run wild.

Saissetia oleæ (Bernard).

Lucban, April 11, 1904, on cultivated plant called "rosal" or "campopot."

Saissetia hemisphærica (Targioni-Tozzetti).

Lucban, April 11, 1904, on cultivated sago palm, and on two undetermined cultivated plants.

Coccus longulus (Douglas).

Lucban, April 20, 1904, on cultivated "macetas," a croton with oak-like white-spotted leaves.

Coccus diversipes, n. sp.

♀. Scale light reddish-brown, quite flat, broad-oval, the anterior end narrowest; length $2\frac{1}{4}$ - $2\frac{2}{3}$ mm., breadth about 2; surface

marked with many large irregularly shaped polygonal areas, about 60 to 150 μ diameter, in each of which is a smaller area of the same general form, and within this sometimes a smaller and occasionally a smaller within that; these areas are marked merely by contour-lines, which show little marginal cracks; they are not destroyed by boiling in liquor potanæ, but they become wholly invisible when the insect is mounted in balsam; the regions between these areas show numerous small gland-spots, which appear blackish. Anal plates long and narrow, 187 μ long, and together 130 wide, posterior lateral side 87 long, anterior lateral side 150 long, tip of plates to hind end of body about 750 μ .

Anterior legs ordinary, femur and trochanter 145 μ long, tibia 80, tarsus 50, the femur not especially slender, its diameter about 45 μ . Middle and hind legs remarkably slender and elongated, with very large coxæ; measurements in μ :—

	Femur and Trochanter.	Tibia.	Tarsus.	Width of Femur.
Middle legs.....	250	105	42	4 ¹
Hind legs.....	265			4 ¹

Antennæ 6-jointed, joints measuring (1.) 30, (2.) 37, (3.) 97, (4.) 27-30, (5.) 25-27, (6.) 55. Joint 3 is slender and smooth, with a whorl of bristles 80-84 μ from base; 6 is slender, with several long bristles. Marginal hairs strongly fimbriate or branched, about 20 μ apart.

Lucena, Tayabas, April 24, 1904, on cultivated fern "parasite."

Very close to *C. acuminatus* ("Signoret") of Green, but not identical; also close to *C. incisus* (King), but that has 8-jointed antennæ. The antennæ of *C. diversipes* are almost exactly like those of *C. rhizophoræ* (Cockerell), and are very similar to those of *Eucalymnatus gracilis* (Hempel), but these insects are otherwise different.

Pulvinaria polygonata, n. sp.

♀. Light brown; ovisac pure white, broad and fluffy, irregular in form; mounted female a little over 3^{mm} long and 2 broad; skin with an irregularly polygonal structure like some *Saissetia*, only the walls of the spaces are perfectly hyaline and colorless, the spaces are about 25 μ diameter; mouth-parts small; marginal spines about 30 μ apart, long, stout, more or less branched at end, but not greatly broadened; stigmatal spines ordinary; anal plates

together forming nearly a square, their length and breadth (of the two together) each about 137μ . Anterior leg measuring, femur and trochanter 215, tibia 150, tarsus (without claw) 75; claws hooked, their digitules fully twice their length, with very large knobs. Antennæ 8-jointed, 5 with a very long bristle; joints measuring, (1.) 50, (2.) 52, (3.) 75, (4.) 57, (5.) 50, (6.) 30, (7.) 30, (8.) 50.

Manila, June 3, on leaves of a cultivated shade-tree, accompanied by a species of *Aleyrodes*.

P. tessellata, Green, has the dermal markings, but it has a bright green fluted ovisac; *P. aurantii*, Cockerell, has similar antennæ, but quite different marginal spines, etc.; *P. eugeniæ*, Hempel, has also similar antennæ, but a different ovisac; *P. tecta*, Maskell, has the dermal markings, but the marginal spines are simple; *P. simplex*, King, has polygonal dermal markings, but otherwise is different.

Pulvinaria tyleri, n. sp.

♀. Smallish, light brown, with a loose, shapeless fluffy white ovisac; mounted female about 1865μ long (full of eggs, which are very large, 570μ long); stigmal spines in threes, the long ones stout and 60μ long, the short about 15; marginal spines stout, not close together, simple or very slightly bifid at end; legs ordinary, measurements of anterior legs; femur and trochanter 220, tibia 168, tarsus (without claw) 92. Antennæ 8-jointed; measurements of joints:—(1.) 40, (2.) 62, (3.) 70, (4.) 40, (5.) 40, (6.) 27, (7.) 22, (8.) 50.

Batangas, April 7, 1905, on "cadena de amor," crowded on the twigs. Quite distinct from *P. psidii* and *P. aurantii*.

Pulvinaria psidii philippina, n. subsp.

♀. Scales and ovisacs matted together in great confusion; marginal hairs about 50μ apart, broad and flattened at end, the margin of the flattened part slightly fimbriated; tibia 225-262 μ long, tarsus 110-117; claw digitules long, with large round knobs, 12μ diameter; bristles of anal ring stout, 200μ long; anal plates ordinary, length 140, anterior lateral margin 87, posterior lateral margin 107. Antennæ 6-jointed, joints measuring, (1.) 50, (2.) 50-57, (3.) 100-105, (4.) 50, (5.) 67, (6.) 95. Joints 2 and 5 each with a very long bristle.

Lucena, Tayabas, April 20, 1904, on a cultivated *Ficus*.

The long tibia, long third antennal joint, marginal hairs, long bristles on joints 2 and 5 of antennæ, etc., all show this insect to be very close to *P. ficus*, Hempel, and *P. psidii*, Maskell. The six-jointed antennæ are distinctive, but may not be constant. It is evidently reasonable to treat the insect as a subspecies of *psidii*, and so far as I can make out *P. ficus* should stand as *P. psidii ficus*.

Aspidiotus simillimus translucens, Cockerell.

Lucban, Tayabas, April 19, 1904, on cocoanut seedling. Length of female 750 μ or rather more; anterior lateral glands 7, posterior laterals 4-5, in a group.

Aspidiotus lataniæ, Signoret.

Lucban, Tayabas, April 6, 1904, on cabbage.

Aspidiotus tayabanus, n. sp.

♀. Scales crowded on bark, not distinctly separable, flat, dark ferruginous, exuviae marked by a distinct dot and ring in grey or yellowish-white, but on rubbing, the second skin appears, bright orange-ferruginous or orange-chestnut; there is a thin whitish ventral film.

Female insect light yellow (after boiling), reniform; no circum-genital glands; dorsal pores few and small; genital orifice about 30 μ anterior to anal orifice, its margin thickened; anal orifice about 7 μ long, oval, distant about 30 μ from tips of median lobes, two pairs of lobes, close together, the median lobes large and elongated, their inner sides practically contiguous, the apex rounded, the outer margin with a strong notch; second lobes of the same general shape, but very much smaller, more pointed, with the notch stronger; spines rather large; a short distance beyond the second lobe the margin presents two little pointed projections, and beyond that come three large broad strap-shaped squames, their ends or sides with a few linear processes; then two more small pointed projections, and beyond that a very fine serrulation of the margin. In the interval between the first and second lobes are two long club-shaped glands or "paraphyses,"

the inner about twice as long as the outer, its rounded end extending beyond the level of the anal orifice.

Lucban, Tayabas, April 11, 1904, on cultivated plant called "rosal" or "campopot," with *Saissetia oleæ*.

Allied to *A. moorei*, Green, and by the club-shaped organs suggesting *A. quadriclavatus*, Green, and *Pseudaonidia clavigera*, Cockerell. The lobes are curiously similar in form to those of *A. forbesi*, Johnson.

Pseudaonidia trilobitiformis (Green).

Manila, May 7, 1904, on *Artocarpus*.

Chrysomphalus rossi (Maskell).

Lucban, Tayabas, March 30 and April 19, 1904, on cultivated sago palm; Lucban, March 30, 1904, on "Nangcanongcaong," cultivated.

Chrysomphalus aonidum (Linné).

Manila, June 5, on cultivated banana; Manila, May 7, 1904, on *Artocarpus*; Manila, June 5, on large spreading palm, cultivated, and May 19, on native palm (like *Orcodoxa*), cultivated.

Chrysomphalus aurantii (Maskell).

Manila, May 7, 1904, on *Artocarpus*.

Parlatoria proteus (Curtis).

Manila, June 5, on *Eugenia malaccensis*, cultivated.

Parlatoria pergandii (Comstock).

Manila, May 19, on aloe-like plant, cultivated. The scales look like *proteus*, but the fourth lobe of *pergandii* is very distinct.

Aulacaspis rosæ (Bouché).

Lucban, Tayabas, on rose, cultivated, March 30, 1904. A variety with the second skin black, tipped with light reddish.

Phenacaspis eugeniæ (Maskell).

Manila, June 5, on a large spreading palm, cultivated. This seems to be *eugeniæ*, but it will be more critically examined by Professor Cooley, who is revising the genus.

Hemichionaspis townsendi, n. sp.

♀. Scale light greyish or yellowish, exactly the color of the back on which it rests, the exuviae a little yellower; shape pyriform, rather broad, varying to nearly circular.

♂. Scale white, bluntly tricarinate, the exuvia very pale yellowish.

♀. Color after boiling light yellowish, with some blue pigment at the cephalic end; length of mounted example 672μ , breadth 600, the insect therefore shorter than usual; sides of segments bulging, forming on each side about four large rounded prominences; eggs in body of female (well-developed with eyes showing) 155μ long; five groups of circumgenital glands, median about 16, anterior laterals about 19 or 20, posterior laterals about 25; anal orifice round, about 12μ diameter, and 112 from tips of median lobes; dorsal glands not very numerous; median lobes contiguous, low and broad (about 12μ long, the two together 22 broad) with four crenulations produced by three notches, the first two being very deep and strong; second lobes quite rudimentary, not or hardly rising above general margin; first spine-like squame small, but the others (three single ones at rather long intervals, and then a pair) very large and long.

Lucban, Tayabas, on bark of *Gossypium*, April 12. The male scales are in groups and conspicuous, but the female scales are so inconspicuous that I very nearly overlooked them. The notches of the median lobes are considerably deeper than in any species figured on Cooley's Pl. IX. The rudimentary second lobes afford a character to distinguish the species from *H. theæ* and *aspidistræ*.

Lepidosaphes cocculi (Green).

Manila, June 5, on large spreading cultivated palm. Probably some forms from elsewhere, found on palms and recorded as *L. gloveri*, may have been this.

Lepidosaphes rubrovittatus, n. sp.

♀. Scales broader than *gloveri*, but narrower than *ulmi* or *beckii*, and of a peculiar greenish-yellow or yellowish-green color; the exuviae dull orange, with a dark red longitudinal stripe down the middle of both skins. Circumgenital glands close together,

the groups forming a sort of broad V, exactly as in *L. serrifrons*; median group of 3, anterior laterals 7 to 8, posterior laterals 4; dorsal glands conspicuous; anal orifice small, about 82μ from hind end; three segments before the terminal area produced laterally, and bearing spines; anterior end with the skin finely striate, but not in the least provided with the spines or projections of *serrifrons*; lobes, etc., similar to those of *serrifrons*; third lobe (second lobule of second) more or less rudimentary, so that it is not readily noticed; median lobes striate, slightly notched on each side, and very slightly inclined to be crenulate; squames all spine-like and simple; marginal oval fusiform gland-orifices very distinct, as in *ulmi*, etc.

Manila, June 5, on cultivated *Eugenia malaccensis*, with *Parlatoria*.

This insect belongs to a group consisting of *L. gloveri*, (Packard), *L. pallida*, (Green), *L. pallida maskelli*, (Cockerell) and itself. It is nearest to *maskelli*, and is perhaps only a variety or race of it, *maskelli* itself being probably a species distinct from *pallida*.

THE COMMON DRONE-FLY

(*Eristalis tenax* Linn.)

Its Prevalence in the Old World, Probably for Centuries, from the Atlantic Ocean to Japan, and the Remarkable Circumstances of its Sudden Invasion of the New World (North America and New Zealand) Between the Years 1870 and 1888.

BY C. R. OSTEN SACKEN

It has been truly said that "chance is the *incognito* of Providence," and I am involuntarily reminded of this saying when I recall the succession of chances which have enabled me to witness the extraordinary history of the invasion of the common drone-fly (*Eristalis tenax* Linn.) into the continents of the New World.

Eristalis tenax had been known for centuries to occur in most of the temperate regions of the Old World, from the shores of the Atlantic Ocean across all Europe through Siberia and China to Japan, but it had never been found in the New World. For twenty years I have been collecting Diptera in North America, north of Mexico, without ever meeting with it. To all appearances, nothing would have been easier than for *E. tenax*, with its aquatic larva, thriving in stagnant and putrescent waters, to have been among the first insects carried across the Atlantic Ocean in one of the innumerable vessels which, for more than four centuries, had been plying between the two continents. That this has never taken place appears to me to add one more to the unsolved problems of the geographical distribution of animals.

It was in November, 1875, that, to my great astonishment, I discovered a specimen of *E. tenax* on a window in Cambridge, Mass., where I resided at that time. Next year I observed specimens in Newport, R. I., and a few years later (when I had already settled in Europe) the species was reported from all the States of

the Union and also from Canada. Further inquiry proved that the fly had not been imported across the Atlantic Ocean, but that it had wandered across the continent from the west, and that it had been observed in St. Louis before 1870. The natural inference from these facts was that it had been imported from Japan to the Pacific Coast, perhaps long ago, and had spread eastward much later, when the necessary conditions for its existence (drains, cesspools, sewers, etc.) had been gradually introduced by civilization across the immense plains which separate the Pacific from the Atlantic Ocean.

Still more astonishing was the almost contemporaneous appearance of *E. tenax* in New Zealand. It had never been found there until it was suddenly discovered in the North Island in 1888, and became widely dispersed in both islands two years later. How is it that, after the failure of *E. tenax* to cross the Atlantic Ocean during nearly four centuries, it reached New Zealand by a sudden leap, probably by way of California, across a distance at least twice as great as that between Europe and North America? The intervening islands of the Pacific Ocean may have served as a bridge to it (it was found in the Sandwich Islands in 1892: comp. Grimshaw, *Fauna Hawaiiensis*, p. 19); still, the simultaneousness of the invasion of such distant regions of the New World within such a brief period of time remains an extraordinary and, it seems to me, unexplained phenomenon. It affords me no mean satisfaction to have had the privilege of witnessing and putting on record the history of this invasion.

NOTE.—*E. tenax* had not been found in South America as late as 1893. About its occurrence on the continent of Australia I have no positive data. (Compare my essay: "On the Oxen-born Bees," etc., 1894, p. 37.)

To trace the rôle of *E. tenax* in past times we must look for it among the mentions of *bees* in history, because this fly, in olden times, was invariably mistaken for a bee. From the frequent occurrence of *E. tenax* in the vicinity of carcasses of dead animals, and especially of oxen, the ancients concluded that bees could be produced artificially from dead oxen. This was called *apes facere* (to make bees), and thus the term Oxen-born Bees (*bugenes melissa* in Greek and *taurigenæ apes* in Latin) became of common use in ancient literature. The method consisted in burying the carcass of an ox and thus producing what was believed to be bees;

but nobody took the trouble of verifying whether these "bees" ever made honey.

This absurd notion prevailed not only among the ancients; it persisted through the middle ages, up to comparatively recent times. The celebrated Italian naturalist, Aldrovandi (1602), the Englishman, Moufet, (*Theatrum insectorum*, 1634,) the learned Frenchman, Bochart, (*Hierozoicon*, 1664,) and other authors of that time considered the practice as a matter of every-day experience. The final confutation of this craze took place when, with the progress of natural science, the belief in spontaneous generation upon which it was based was abandoned and replaced by the doctrine of evolution, represented by the formula: all life begins with an egg (*omne vivum ex ovo*) proclaimed by later naturalists, by the Englishman, Harvey, (1651) and the Italian, Redi, (1668).

Under the heading "On the Oxen-born Bees of the Ancients (Bugonia) and Their Relation to *Eristalis tenax*, a Two-winged Insect" (xiv + 80 pages; Heidelberg, J. Hörning, 1894), to which in 1895 I added "Additional Notes In Explanation of the Bugonia-lore of the Ancients" (*ibidem*, 23 pages), I published an elaborate research upon the whole question, based upon more than one hundred references to the existing literature. I concluded the first of these essays (p. 37) with the following words:

"Except the silkworm and the honey-bee, I hardly know of any insect that can show an historical record equal to that of *Eristalis tenax*. The record begins in the dusk of prehistoric times, and continues up to the present date. In its earliest days *E. tenax* appears like a myth, a misunderstood and unnamed being, praised for qualities which it never possessed, a theme for mythology in prose and poetry; later on, the bubble of its glory having burst, it gradually settles into a kind of commensalism with man, it obtains from him 'a local habitation and a name,' it joins the Anglo-Saxon race in its immense colonial development, it vies with it in prodigies of fecundity, and at present renders hitherto unrecognized services in converting atrocious 'stuff' into pure and clean living matter!"

In the Book of Judges, XIV, the story of Samson (who, after killing a lion, found, some time later, a hive of bees in the carcass and ate the honey) has been for centuries a puzzle for interpreters. Professor Max Müller, at Oxford, saw a *solar myth* in it,

like the story of Hercules, to which he attributed a similar origin. (The same explanation is found in the recent novel of B. Björnson, "Auf Gottes Wegen.") A more natural explanation was offered by me in my work on the Bugonia (p. 18) that Samson's bees were carcass-born flies, *Eristalis tenax*. Dr. Adalbert Merx, Professor of Scriptural Exegesis in Heidelberg, accepted this interpretation with joy, as it proves the truth of an otherwise incredible story. The hive and the honey were, in this case, a stretch of imagination of the story-tellers (l. c. p. 62-68. I have reproduced in English translation Prof. Merx's article on this subject).

I closed my chapter on the Bugonia-lore of the ancients with a sentence of Goethe (l. c. p. 38).

"Man sieht nur was man weiss."

NOTES ON SOME IOWA PLANTS.

BY B. SHIMEK.

Recent discoveries of species new to the state, and the segregation of forms hitherto confused with other species, have added materially to our known state flora, and the latter cause has resulted in the elimination of names heretofore applied to species which are now considered distinct. In the following notes a brief discussion of some of these interesting cases is presented.

Ricciocarpus natans (L.) Corda. This floating liverwort was found by the writer in great abundance in a pond near Scarville, Winnebago county, late in the fall of 1902. It is here reported for the first time from the state.

Woodsia ilvensis (L.) R. Br. The discovery of this interesting fern in Iowa was reported by the writer at the St. Louis meeting of the A. A. A. S. last winter. It was found upon exposures of St. Peter sandstone in Winneshiek county. Mr. O. M. Oleson has since submitted specimens which were collected at Ft. Dodge. It has been known from Wisconsin and Minnesota, but is new to Iowa. Its occurrence, therefore, at two such widely separated localities in the state, is of special interest. In Winneshiek county it was found at two points near Hesper, both about half a mile from the state line.

Smilax pseudochina L. This species, and *S. hispida*, with which it has been confused, are our only native woody endogens. Well-defined specimens of this species were collected by the writer in Cerro Gordo county, and by Mr. J. E. Cameron in Delaware county. It will probably be found widely distributed in the state. It was reported in Vol. 38 of the Transactions of the Iowa Hort. Society, p. 461.

Salix missouriensis Bebb. An interesting form of this species was collected on the sand-dunes west of California Junction, Harrison county, May 19th, 1903. Fruiting specimens were then

common, but most of the capsules had dehisced. Several shrubs and small trees still bore staminate flowers. In this habit of producing staminate flowers irregularly through spring and early summer, this species resembles *S. ricularis*. The specimens on the sand-dunes are dwarfed, more or less tufted or clustered, and approach *S. glaucophylla* Bebb, both in the character of the leaves and the style. Twigs which were grown in water, however, developed leaves characteristic of *S. missouriensis*. Leafless staminate and pistillate twigs, collected at the same place by Messrs. Bruce McGavern, David Moore, and P. Tierney, April 18, 1904, later developed typical leaves of *S. missouriensis*, but the pistillate flowers showed a distinct, rather slender style, thus approaching *S. glaucophylla*. The latter species occurs on the sand-dunes along Lake Michigan, and is evidently closely related to *S. missouriensis*, if, indeed, it does not connect with it.

Populus candicans Ait. Native, or if introduced, well-established, on river bluffs in Winneshiek county, especially along the Upper Iowa above Kendallville. While this has been cultivated quite commonly it has not heretofore been recognized as belonging to our flora.

Corylus rostrata Ait. Much doubt has been entertained concerning the occurrence of this species in Iowa, but the writer found it sparingly in the vicinity of Kendallville, Winneshiek county, in 1903. Several specimens were observed on rather low ground at the base of a shaded rocky slope.

Quercus borealis Mx. f. This is the common black oak of higher dry grounds in the northern part of Winneshiek county. It has thin, very brittle bark; the leaves are small and regularly lobed, like those of the red oak though rather more deeply, and the acorns are intermediate in their character between those of *Q. rubra* and *Q. velutina*. The inner bark is light yellow, and very brittle. Some of the phases of this species approach *Q. schueckii* which is more common in the north-central part of the state. Our Iowa forms agree well with Engelman's specimens of *Q. ambigua* Mx. f. (*Q. borealis*) in the Shaw herbarium at St. Louis.

Asarum acuminatum (Ashe) Bicknell. This and the following species were formerly included under *A. canadense* L., a

species which does not occur in the state. All published references to *A. canadense* are, therefore, valueless so far as concerns this state. *A. acuminatum* is the common species of mossy, shaded, rocky banks, and is readily recognized by its long-acuminate calyx-lobes. The herbarium of the State University contains specimens from Emmet county (*R. I. Cratty*), Delaware county (*J. E. Cameron*), Dubuque county (*J. A. Anderson*), and from Johnson and Cerro Gordo counties, collected by the writer. This is the more common *Asarum* of the northeastern part of the state.

Asarum reflexum Bicknell. This species is readily recognized by its smoother surface, and shorter, reflexed calyx-lobes, as well as by its habit. It grows in low, rich alluvial woods, in company with *Claytonia virginica*, *Isopyrum biternatum*, *Cardamine purpurea*, etc. The University herbarium contains specimens from Polk county (*E. Des Moines Highschool*), Pottawattamie county (*J. E. Cameron*), Wayne county (*F. A. Stromsten*), Muscatine county (*Ferd. Reppert*), and Johnson, Muscatine, Monroe, Appanoose, and Cerro Gordo counties, collected by the writer.

Polygonum camporum Meisn. This and the following species were also reported at the St. Louis meeting of the A. A. A. S. This species has heretofore been confused with *P. ramosissimum* Mx., but is very distinct. It is found upon sandy ridges in Winnebago county, and westward.

Polygonum douglasii Greene. This is locally very common on St. Peter sandstone exposures in the northern part of Winnebago county, where it grows on sandy talus with the comparatively rare *P. tenue* Mx. Flowering specimens were abundant in August, 1903.

Talinum parviflorum Nutt. This was reported* by the writer from Lyon county as *T. teretifolium*, but our specimens are undoubtedly *T. parviflorum*. Arthur also reported *T. teretifolium* from the same locality in Lyon county,† and probably made the same error. The species is locally rather common at two points near the northwest corner of the state, where it grows on Sioux Quartzite exposures, in crevices and upon the scant dry soil which accumulates in places upon the rock.

* *Ia. Geol. Sur.*, Vol. X, p. 175; *Proc. Ia. Acad. Sci.*, Vol. IV, p. 73.

† *Proc. Dav. Acad.*, Vol. III, p. 169.

Brasenia purpurea (Mx.) Casp. This species, better known as *B. peltata* Pursh, was collected by the late Ferd. Reppert in Muscatine county, and was reported in the Proc. of the Davenport Acad. of Sciences, Vol. VIII., p. 202. This was the only record of its occurrence in this state until the writer discovered it growing commonly in Dead Man's Lake, in the northeast corner of Hancock county, during the last week of September, 1902. It was then fruiting abundantly.

Atragene americana Sims. This species, hitherto known from Winneshiek and Delaware counties only, was recently reported in the Trans. Iowa Hort. Society (l. c.). It is found sparingly upon rocky bluffs and banks in the northwestern part of the county, and probably occurs in the adjoining portions of both Delaware and Clayton counties. Its conspicuous flowers appear about the middle of May.

Ribes missouriensis Nutt. This species was also reported with the preceding, but without specific localities. The University herbarium contains specimens from Pottawattamie county (*J. E. Cameron*), and from Harrison, Lyon, Webster and Johnson counties, collected by the writer. It was formerly confused with *R. gracile*, and seems to be the more common species, especially westward.

Opulaster intermedius Ryd. This form grades more or less into *O. opulifolius* (L.) Kuntze, and is probably a mere illustration of the tendency of some species to develop xerophytic characters, such as increased hairiness of the surface, etc., as they extend westward into the drier, more open prairie portions of the state. Specimens referable to this form were collected by the writer in Johnson county.

Rubus baileyanus Britt. This species was also reported in the Trans. Iowa Hort. Society, l. c., p. 463, where a typographical error assigns it to the southeastern part of the state. The specimens there reported were collected in Winneshiek county. The species has since been collected by the writer near Unionville, in Appanoose county, where it grows on moist banks in rather deep woods.

Potentilla tridentata Sol. This species was first reported in Iowa from Hesper, Winneshiek county, by Arthur,* and is still

* Proc. Dav. Acad. Sci., Vol. III., p. 169.

very common on the St. Peter sandstone exposures northeast of Hesper. Fruiting specimens were common in August, 1903, and the leaves were afflicted with a *Phragmidium*, probably *fragariæ*, a new host for this fungus in Iowa.

Aronia nigra (Willd.) Britt. This species was also recently reported by the writer,* together with the following species with which it was found growing on exposed ledges of St. Peter sandstone northeast of Hesper. Some of the specimens were in fine fruit in August, 1903.

Prunus pumila L. Found with the preceding. It is rare, only a few plants being found on the most exposed parts of the sandstone ledges.

Scrophularia marylandica L. This and the following species were formerly called a variety of *S. nodosa*. They differ both in structure and in habit. This species is readily recognized by its deep purple abortive stamen, and by the more puberulent lower surface of the leaves. It is found more frequently in woods and on lower grounds. The University herbarium contains specimens from Jones county (*J. E. Cameron*), and from Johnson, Cerro Gordo, Lyon, Winneshiek and Lee counties, collected by the writer. Earlier records of this species in the state are of little value, because they undoubtedly in part include the following species.

Scrophularia leporella Bick. This differs from the preceding species in having a greenish-yellow abortive stamen, and smoother leaves. It grows more commonly on the prairie, and in openings and along borders in wooded country. The University herbarium contains specimens from Johnson, Floyd and Winneshiek counties, collected by the writer. It is, however, much more widely distributed than this would indicate.

* Trans. Ia. Hort. Soc., Vol. XXXVIII, p. 466.

MURAL RELIEF FIGURES OF EL CASA DEL TEPOZTECO

BY J. WALTER FEWKES

On a recent visit to Mexico the author made an excursion to Cuernavaca in order to visit¹ the wonderful ruin called Xochicalco in the state, Morelos. He likewise visited the little-known temple, El Casa del Tepozteco, situated in the mountains above the Indian pueblo, Tepoztlan. The mural figures described in the following pages occur on the walls of the latter ruin.

In order to visit this ruin the author and a companion² left the railroad between Mexico and Cuernavaca at the station called El Parque, which is nothing but a solitary train house on the mountains. A short walk from this place brought us to the Cerro del Tepozteco, on the apex of which, a thousand feet above the plain, could be readily seen the ruined temple appearing as a white spot on the side of the mountain.

After a climb up one of the most precipitous cliffs³ known to him, with the exception possibly of some parts of the old trail from the Colorado River to the rim of the Canyon, the author reached the summit of the mountain, where a camp was made in the thatched cabin of the Custodian. In this elevated pinnacle the author and Dr. Le Baron remained over night and the greater part of two days, which were profitably occupied in a study of the monument and its various parts. Several good photographs and a few notes were obtained on this short visit, but the data

1. This article is published by permission of the Secretary of the Smithsonian Institution.

2. The author was accompanied on this excursion by Dr. Eugene Le Baron of Cuernavaca, to whom he is indebted for many kindnesses, including the photographs reproduced in plates I-III.

3. This trail has been much improved of late by the introduction of iron ladders and platforms so that the difficulties in following it have been much reduced.

most prized is a series of drawings of certain figures on the banquette of the interior walls made by the Custodian, Sr. B. Verazaluce. On comparing these drawings with the original reliefs on the temple walls their fidelity in minute details was apparent, and later, when it was possible to consult existing descriptions and photographs of the ruin, it was recognized that this series is more complete than any that have yet been printed. It is especially fitting that this important series should be published not only from its intrinsic value as illustrating the designs, but also because it was made by one of the natives of Tepoztlan pueblo to which we already owe so much in the preservation of their highly-prized ancient monument.

The ruined temple, El Casa del Tepozteco, was formerly introduced to the archaeological world by a native of Tepoztlan, Sr. Francisco Rodriguez, the talented engineer who is now Acting Director of the Museo Nacional of Mexico. A brief communication calling attention to the ruin was made at the meeting of the Americanists in Mexico in 1895 and was later¹ published in the proceedings of the session of the year. Under his initiation and personal supervision the Tepoztlan² Indians, who take much pride in this ancient monument of their race, cleared away the accumulated debris and improved the trail leading to it from the plain, thus making it accessible to visitors.

Penafiel, in his work on Teotihuacan³ published in 1900, claims that the Casa del Tepozteco was first described by D. Jesus Quiroz, but gives no reference to the place where this description appeared. He reproduces Saville's illustrations in part and compiles his short description mainly from that of Rodriguez. The account by Penafiel adds little to what was already known of this ruin. Although Sr. Rodriguez's article before the Congress of the Americanists was a brief one it attracted much attention and led several archaeologists to visit the temple, and later to the

1. Congress Internacional des Americanistas. Actas de la undecima Reunion. Mexico; pp. 233-237. 1895.

2. On the 7th September, yearly, it is said that the *Teponaxtli* or drum kept in Tepoztlan is carried up to this temple and beaten. On the following morning, at sunrise, certain rites are performed in the temple. There is likewise a personation of the "Rey de Tepoztlan," who receives "Ambassadors" from neighboring pueblos.

3. Teotihuacan. Estudio Historico y Arqueologico, pls. 76, 76.

appointment of a custodian of the ruin. Among others who climbed the precipitous Cerro de Tepozteco under guidance of Sr. Rodriguez, was Professor Marshall H. Saville of New York, who made excellent photographs that he later published¹ in his valuable articles on this subject. One of the important contributions made by Saville to our knowledge of the ruin was a determination of the date of its construction obtained from a slab on which were cut relief figures. This stone was found in the lower stone of the pyramid and later removed to Mexico. A ground plan of the ruin made by Rodriguez also appears in the same work.

Dr. Seler² supplemented Saville's account with many important suggestions regarding the patron god to whom the temple was dedicated and the inscriptions on its walls. He likewise identified several of the relief designs here considered, including one not now in place and therefore not considered in our series. This slab formerly occupied what is now a gap in the middle of the east wall and was apparently the key not only to the age but also to the character of the worship in the old temple.

Architecturally the ruin consists of a temple standing on a solid pyramidal base with almost perpendicular sides, the elevation of which is broken by two narrow shelves or terraces. The superstructure or building on top of the pyramid, which was the temple proper, opened to the west, being approached by two broad stairways, an upper now somewhat dilapidated and a lower rising from a landing to which access was gained from a lower level. The walls of the once roofed temple enclosed two rooms, a rear chamber, which may be called the cella and an anteroom. The former was entered by a passage-way in the partition, occupying the space between offsets arising from the north and south walls. The anteroom contains, besides other structures, the

1. Bulletin American Museum of Natural History, Vol. VIII, Monumental Records, Vol. I. No. 1, July, 1897.

2. Die Temple pyramide von Tepoztlan. Globus, Bd. 73, No. 8, pp. 123-129. Gesammelte Abhandlungen Sprach und Alterthumskunde. Berlin, 1904, 2nd vol., pp. 200-214. The article in Globus is translated, "Temple Pyramid of Tepoxtlan," in Bulletin, Bureau of American Ethnology, No. 28, pp. 341-352. Since these articles were written new excavations have been made in the neighborhood of the base of the temple of Tepozteca and important undescribed walls and other structures brought to light.

remains of foundations and pillars. The structure which especially concerns us in this article is a narrow ledge slightly raised above the floor, extending around the north, south and east walls of the cella, and a part of the north and south walls of the anteroom. It served as a kind of banquette or seat, recalling a similar structure in Hopi kivas. The vertical face of this banquette is constructed of square or rectangular blocks of stone, the surface of which is ornamented with figures cut in low relief. The edge of the seat projects slightly beyond the rise and is also decorated with relief designs. The rock used in its construction is the common building stone of the present day, a kind of lava (*tezontli*). This stone is readily worked and is softer than that used at Xochicalco and some other ruins. The carved relief figures were painted red. The two offsets that stand out from the north and south walls forming the partition separating the cella from the anteroom have no banquettes and are destitute of relief decorations on their east side, although their other surfaces are elaborately ornamented with geometrical relief figures that will not now be considered. There are at present no mural decorations on the walls of the cella or antechamber above the banquette, although remnants of color show that formerly paintings and other ornamentations adorned this part of the wall.

For convenience of reference and description the relief figures are arranged and numbered beginning at the northwest corner of the cella, passing from it to the east or rear wall, then to the south wall, ending in the southwest corner. Then follow the figures on the banquette of the anteroom, where the figures are imperfect and the series incomplete. There are, all told, sixteen figures now present on the upright walls of the cella, four on the north, four on the south, and eight on the rear wall. The number of small relief figures on the projecting edge of the seat is unknown, but there are more than twenty¹ in this position. The original relief figures from which these drawings were made do not follow each other in a continuous series. There is a break directly opposite the entrance into the cella, and at one or two other points, from which stones were removed a short time ago. The position of the former is between numbers 7 and 8; that of the latter is shown in the drawings.

1. No resemblance was noted between these signs and the Mexican day symbols.

The little that has been published on the relief figures of the inner wall of the Casa del Tepozteco is derived from photographs published in Saville's descriptions of the ruin, which appear to have been used in Dr. Seler's interpretations. These photographs show only parts of the series, and in one or two instances are too indistinct for outlines of relief designs.

The author will begin his comments on Sr. Verazaluce's series of drawings with those on the north side of the cella at the northwest corner, where there are four figures, Nos. 1-4, carved in relief on seven stones, six of which are now, 1905, in place, the seventh having been removed later than Saville's visit. According to Dr. Seler, the design No. 1 represents a bundle composed of several objects bound together, having a water or blood symbol issuing from each side. The design No. 2 on the third and fourth stones is identified by the same authority as *atl*, water, with an eye, *ixtli*. The circle here identified by Seler as an eye is elsewhere. No. 4, duplicated and having a somewhat modified form is there identified by the same author as a shield.

An elaborate design, No. 3, on the fifth stone, according to Dr. Seler, represents a pulque bowl with two lateral ring-like appendages. On the middle of the design is depicted the half-moon-formed nose ornament, *yacametzli*, a characteristic ornament of the Pulque god.

No. 4, according to Dr. Seler, represents war, *yaoyotl*, consisting of a shield, spears and banner.¹ The part of this design that is cut on the sixth stone shows the points of the spears. The symbol in the lower right-hand corner represents *blood or water*. Apparently Dr. Seler had no available material adequate for the identification of the relief figures on the east wall, for he does not discuss the designs that are found in this place.

The relief on the east banquette are well made and apparently significant as their position would imply. The series of decorated stones is broken midway or directly opposite the entrance into the cella by absence of a decorated stone. This space was formerly occupied by a slab bearing one of the most important of all the mural designs of the temple.

On the north banquette of the cella, or on the left of this space,

1. This design closely resembles that on the "Victory Stone" or *chimalli* near Cuernavaca.

the four stones arranged in a series have the designs, Nos. 5-7: on the banquette, at the observer's right hand, there are seven stones with five designs, Nos. 8-12, one of which, No. 6, the median of the three former, repeats a constant symbol among the mural designs.

The first, No. 8, of the five on the right side of the middle of the east wall is duplicated on the north wall by a figure in which the conventional water symbol plays an important part. In the middle of this figure, No. 9, there is represented an object that might be interpreted as a nose ornament of the Pulque god, but the whole figure, unlike that elsewhere mentioned, has no resemblance to a pulque cup or bowl.

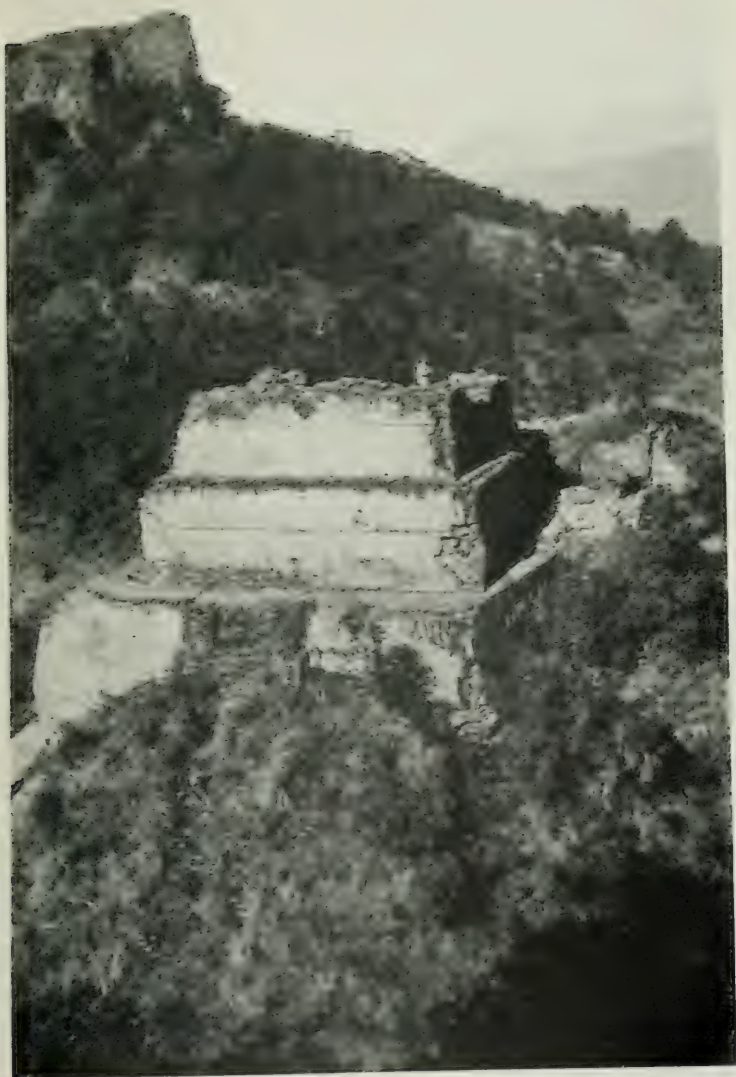
No. 10, the third design in this series, somewhat resembles a hatchet with unknown objects tied to the handle. The following figure, No. 12, is like a wreath with enclosed designs representing water and feathers.

Among the symbols that once decorated the edge of the seat there are nine which are well preserved, but the tenth is somewhat mutilated. Dr. Seler has suggested that the figures on the edge of the banquette represent day signs, but the material at hand is not sufficient to verify or disprove this suggestion. On the row of six stones forming the south side of the cella there are four relief designs.

No. 13, the first figure on the banquette at the left or east end, according to Dr. Seler, represents a skull from which issues blood or water which is represented as flowing over the surface of the second stone. The following figure, No. 14, according to the same author, is the symbol *atl*, water with an eye, *ixtli*, upon its surface. This figure occupies a greater part of the exposed surface of the second and third stones on this side. The signification of the third design, No. 15, is not clear that it is connected in some way with "blood or water" as the accompanying symbols would appear to indicate. The most elaborate design on the walls of the cella is a relief identified by Dr. Seler as a dog (*itzcuiltli*) and undoubtedly representing some carnivorous animal. The appendages to the arch are considered by the author above mentioned as feathers of the *quetzal*, concerning which identification he is, however, in some doubt, as he later adds, "das ich wederum nicht sicher zu deuten ware."

In addition to the relief figures on the cella walls, there are similar designs on the vertical stone slabs, and fragments of a seat on the north and south sides of the anteroom, evidently parts of a large series. Four figures, two of which resemble certain reliefs on the cella walls, still remain *in situ* on the north side and on the opposite wall there are likewise two reliefs, one of which is duplicated on the north wall and on the seat of the inner room.

The relief designs of El Casa del Tepozteco above described are among the most instructive relics of serial paleography to be found in place north of Chiapas. These reliefs are now in their original place on the banquette of the Casa del Tepozteco and are represented in the accompanying figures. As shown above, plausible suggestions have been made of the meaning of certain of these designs but many others are not yet identified.



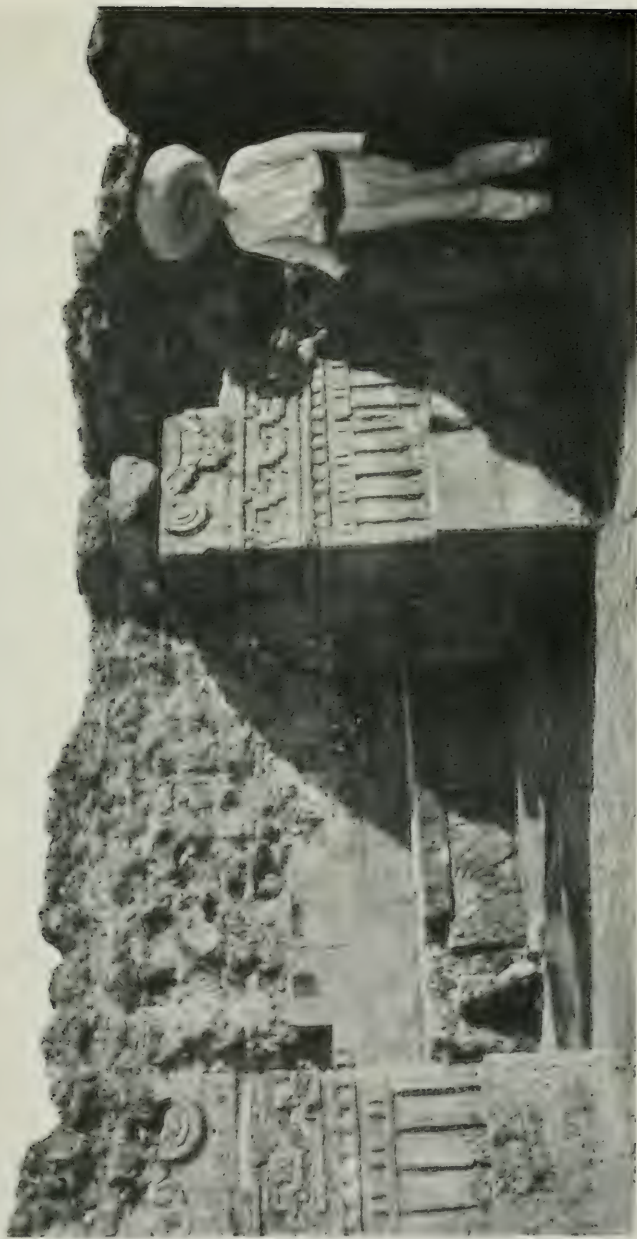
EL CASA DEL TEPOZTEGO (East Side)



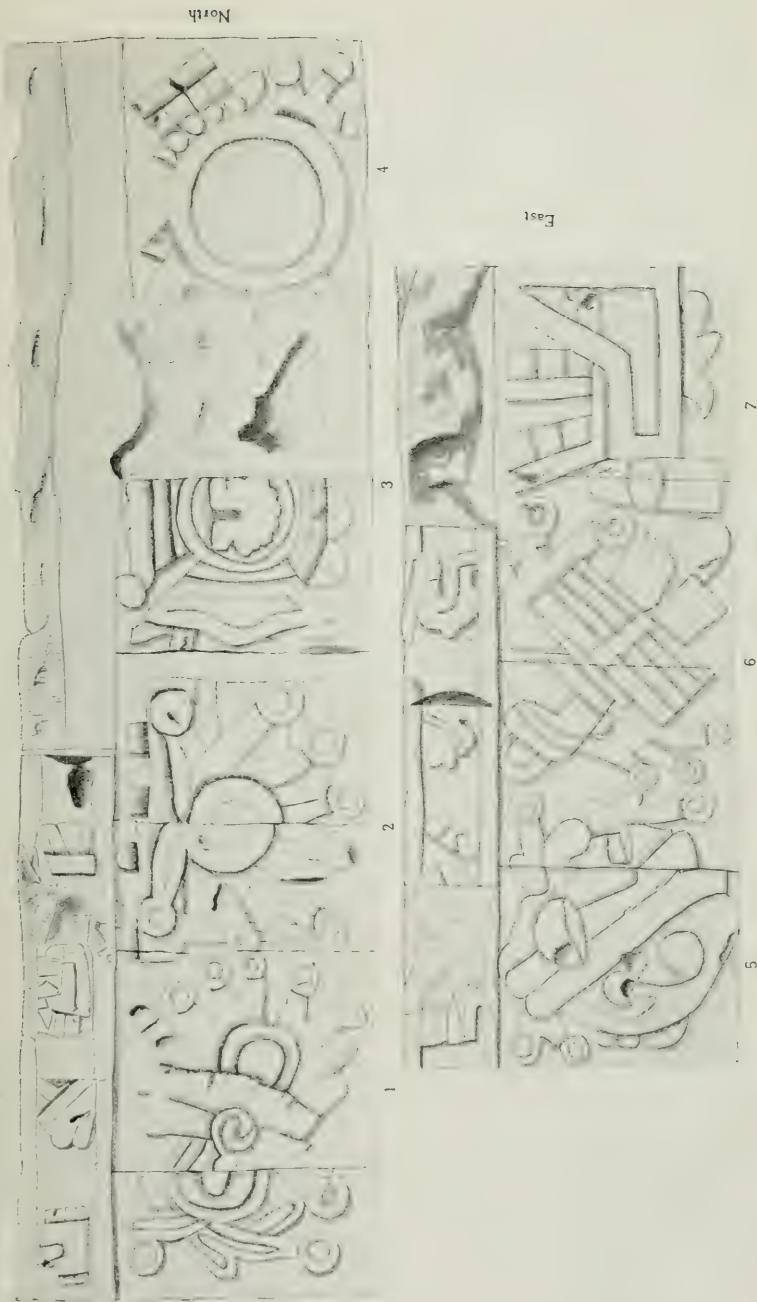
ANTEROOM, EL CASA DEL TEPOZTEGO

Proc. Dav. Acad. Sci., Vol. X

Photographed by Dr. E. Le Baron



EL CASA DEL TEPOZTECO (Entrance to Cella)

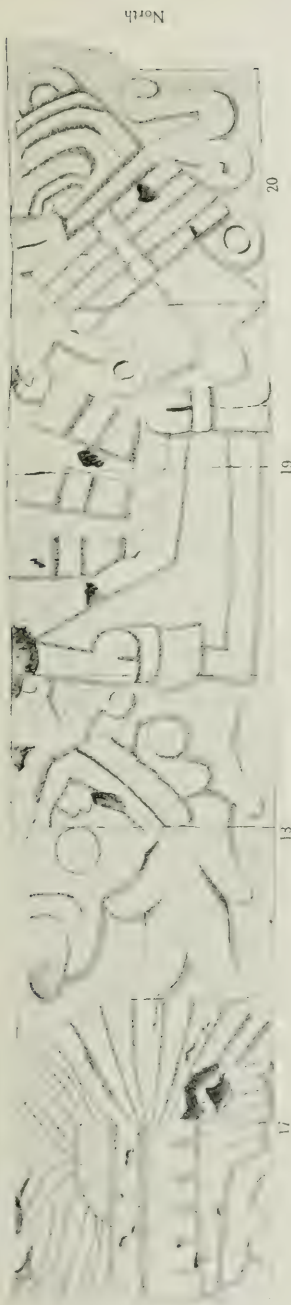


BAS-RELIEFS ON SEAT OF CELLA



BAS-RELIEFS ON SEAT OF GELLA

B. Veracruz, ad nat.



BAS-RELIEFS ON SEAT OF ANTEROOM

ON CERTAIN FOSSIL PLANT REMAINS IN THE IOWA HERBARIUM

BY THOMAS H. MACBRIDE

The herbarium of the State University of Iowa contains a not inconsiderable amount of paleobotanical material, the gradual accumulation of many years. Of these accumulations the greater part consists of thousands of leaf-prints from various beds, both in the state and outside its boundaries; but certain plant-stems and fragments of the woody parts of ancient plants form also a no less valuable part of the collection, and to some of these, perhaps, present attention may for a little with profit be directed.

In the investigation of fossil stems the student is confronted at once by certain obvious disadvantages. In the first place his material is always more or less fragmentary. He has, in the main, only microscopic structure as a basis of identification. This is the more unfortunate since in the study of the existent types all sorts of characters prove more convenient than these to which we are here largely, sometimes entirely, limited. In the present problems ordinary experience, therefore, brings us less assistance.

The determination of specific difference by considering microscopic structure of the stem alone would be difficult enough did we compare the forms that stand about us; how much is that difficulty increased when we attempt to compare with existing types structures that belong to a different geologic age!

In the second place, the material to be studied is often but imperfectly preserved. Silicification is sometimes attended by secondary crystallization or has been in various ways disturbed so that the structure is obscured, and tantalizes the student by suggesting that which cannot be exactly ascertained. This is true also even of material fossil, but not silicified. Wood from pleistocene deposits is not infrequently obscure in microscopic structure although, at first sight, well preserved.

Under these circumstances the study of such material would seem to offer little encouragement indeed; and yet it has seemed better to accumulate and record some of the facts we have, in the expectation that these may at length, in some future day, become a part, however small, of a body of knowledge sufficient for more exact inference and conclusion, and so help men in that day better to understand and realize the orderly succession of the flora of the world.

Our fossil stem-fragments fall naturally into two divisions according as they represent paleozoic or pleistocenic material, and we may conveniently present them in this order. As is well known, the coal-bearing strata everywhere offer abundant casts which have been sufficiently described as *Lepidodendron*, *Sigillaria*, *Stigmaria*, etc., and our collections are not destitute of these things; but these will not be here considered. We consider in this discussion only such of our fragments as lend themselves to sectioning or in such way reveal the original microscopic structure, and only such of these again as show a reasonably secure identification. The paleozoic stems studied are all silicified: the pleistocene material is only slightly changed; would be termed half-rotten wood.

PALEOZOIC STEMS.

PTERIDOPHYTA.

Our pteridophytic material consists first of several fragments of beautifully preserved *Sigillaria* stems. These are only fairly well shown in the accompanying illustrations. No illustration can give exact idea of the clean beauty of the preserved material. Fresh material was in some ways never finer. For the sake of reference we have ventured to give the material in hand a name, with the distinct understanding that specific characters are in the case largely a matter of assumption.

Sigillaria calvini Macbr., n. s. Plates I, II, III, IV.

The specimens upon which, for sake of reference, this species is founded are three. They belong, as will appear, possibly to two or three different plants, but show in so far identical structure.

A. The fossil described is fourteen centimeters long and about

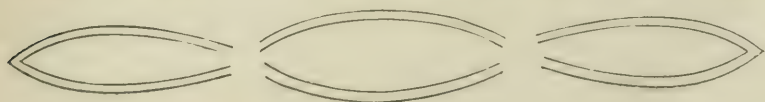
five thick and represents almost throughout the characteristic scalariform woody tissue described below in detail. The specimen has been subject to some compression and in fact represents perhaps no more than one-half the original trunk, as in cross-section the wedges that make up the wood-cylinder have a length of three and one-half centimeters. From the curvature of the circle bounding a section of the stem we estimate the original diameter of the woody cylinder as ten centimeters, which would leave for the pith a diameter of four centimeters. This pith seems to have disappeared completely before silicification.

The cortex in the present specimen is also almost entirely lacking. If we may judge from traces present, the entire cortex seems to have been converted into coal.

B. The second specimen so exactly resembles the first in general detail that it may be assumed part of the selfsame trunk. It comes from the same place and was furnished by the same collector. This specimen measures about ten centimeters in length and about five centimeters in greatest width. Of this width about one and one-half centimeters represents the persistent remnant of the inner cortex. Plate I, Fig. 1. The woody part of this stem has been perfectly silicified, but has been subject to no compression, no distortion, and the entire structure is perfect.

C. The third specimen of the set, about twenty-five centimeters in length, is a portion of a stem entirely flattened by pressure applied previous to silicification. The woody cylinder, stele, was comparatively thin, seven or eight ^{mm.} in thickness, but the total diameter of the stem apart from cortex must have been several centimeters, as will appear from the description following:

The outer cortex seems to have, as usual, passed into coal. Very little of the inner cortex remains; perhaps only a trace obscurely fluted as in *Sigillaria*, and with traces here and there of the ordinary leaf-scar, the central pit usually discoverable. In flattening, the medulla seems to have disappeared altogether and the stele or hollow cylinder of this woody tissue collapsed by breaking into a succession of small arcs which are conjoined by



their ends. At least three of these arc-sets resulted from the breaking down of the cylinder under a uniform lateral pressure. In the process of flattening the cylinder, under a tangential cleavage, separated as upon a line of growth, in such fashion that the older wood parted easily from the younger, leaving these parts to form singular flattened, delicately fluted columns, of which the sections are shown in the accompanying diagram. See also Plate I, Fig. 2, and Plate II, Fig. 1.

The primary or younger wood which forms the walls of these columns is made up of scalariform ducts of unusual width, .010-.014^{mm} in diameter. These are of varying length and marked by slender, distant, transverse thickenings which must have lent to the structure entire, lightness with considerable strength. The secondary wood is composed of similar ducts about one-half as great in thickness and increasing in diameter towards the periphery; but the secondary wood is everywhere shot through by cell-masses representing medullary rays and in this particular differs in marked manner from the inner or primary structures.

In all three specimens the general structure is essentially the same; in each the secondary wood is prominent, distinguishable by its smaller cells; but in B the primary wood is wholly lacking. Medullary rays, as stated, characterize the secondary wood only. Plate II, Fig. 2, and Plate III, Figs. 1 and 2. These are very imperfectly developed, uneven and irregular; sometimes consisting of a single row of transverse cells only, sometimes of many, forming, in section, a figure several cells high and two or three cells thick. We have not been able to trace the continuity of the medullary system with leaf structures in the cortex, as is to be expected. This, partly because it is not deemed advisable to attempt further mutilation of our material. The cortex, where still in place, was evidently largely decomposed prior to silicification. Most of the structure has been replaced by mineral deposits in which only crystalline organization is evident. Occasionally, however, remnants of the same curious tracheary tissue appear which has been above described. These remnants doubtless represent the woody strands of foliar organs. Plate IV, Fig. 1. The medullary cells also show scalariform markings and seem not dissimilar to the prosenchymatous elements.

The relation between primary and secondary wood is made clear

in several sections. Plate IV, Fig. 2. On the outer side of the primary stele merismatic cells developed. These gave rise outwardly to the secondary wood much as cambium in the modern exogen gives rise to phloem. The difference between the ancient structure and the modern appears, however, in that in old *Sigillaria* growth seems to have proceeded by differentiation of the outer meristem only. Also, this differentiation was apparently slow; the cells set off were like the trachea of the primary wood but of small diameter, and surprising as it may seem, capable of slowly growing in size as they were pushed farther and farther out from the stem center. As stated, in the secondary wood the cells of greatest diameter are peripheral, but on the outer face of these there is no indication whatever of a second meristem. The woody tissue was probably pushed out into a parenchymatous cortical mass similar to that which made up the medulla, and which must have given way in every direction before the energy of endogenous structures whether of stele or leaf-stems. These apparently followed for some distance the course of the primal axis.

It may be further remarked, as is evident in our plate, Plate IV, Fig. 2, that the line of separation between the two phases of woody growth in the stem is not a simple curve such as is met, usually, in modern stems, but is strangely sinuate. This gives to the inner stele, where freshly exposed, a peculiar fluted appearance otherwise difficult to understand. See also Plate I, Fig. 2. It would seem as if the merismatic cells themselves arose not as a continuous sheath, but rather as strands which presently become laterally continuous.

This peculiar stem is referred to the genus *Sigillaria* because of the leaf-scars on the surface of the ribbed stem, and because of the microscopic structure above detailed. As to specific identity it may be compared with *S. menardi* Brogn., from which the different structure of the primary wood-cylinder easily separates it. The same peculiarities of structure seem to separate the Iowa material from *S. spinulosa* Germ. In our Iowa specimens the primary cylinder is well developed, of large tracheides without rays or any indication of individual bundles. The merismatic tissue which appears on its outer surface shows, by no indications now legible, any relationship to the older or primary structure.

All specimens referred to *S. calvini* are from the Des Moines

stage of the Upper Carboniferous, as exposed near Panora, Guthrie county, Iowa. The specific name is in honor of Professor Calvin of the University, through whose courtesy the material came to my hand.

Psaronius borealis Macbr., n. s. Plates V, VI.

The fossil here described is represented by several fragments of a pteridophytous stem about ten centimeters in length and six in width. The whole specimen is strongly impregnated with iron, probably hæmatite. The iron deposits are so extensive as to have replaced almost entirely the vascular parts of the associated structures. The central mass of the stem seems to have been composed of two elements, a parenchymatous, as we infer from the homologies of the case, now wholly lost and replaced by sand, and a vascular element preserved only in part, but showing the band-like form characteristic of the stems of larger ferns, as, for instance, some *Cyatheas*, where the section of each bundle is arcuate with the tips of the arc more or less reversed or flexed. This feature of the fossil is indicated in Plate V, Fig. 1. The entire stem, when perfect, must have been fifteen or eighteen centimeters in diameter.

The outer part of the stem, Plate V, Fig. 2, much better preserved than the central axis, shows a vast multitude of vascular strands more or less parallel to each other and to the principal axis; not straight, however, but interwoven, grown through each other apparently in a most intricate mass. Between the strands a crude, rather thick-walled parenchyma is seen. Each strand has for its center a fibro-vascular bundle of the concentric type, showing scalariform ducts of unequal diameter; but the bundle is itself surrounded by a strongly developed sheath or mass of sclerenchymatous cells everywhere well preserved. Plate VI, Figs. 1 and 2.

The generic reference of this fossil would seem sufficiently clear. Specific distinctions here, as elsewhere, are purely tentative, but for convenience of reference the specimen may be called by a specific name. The distribution of the principal vascular strands may possibly here suggest specific characters, although in existing forms such arrangement is generally significant of a much larger group.

Our material is from Hardin county, Iowa, and represents, apparently, the Des Moines stage of the upper Carboniferous.

SPERMATOPHYTA.

GYMNOSPERMÆ.

CONIFERALES.

The collections of the University contain a very considerable number of fossil stem-fragments referable to coniferal species. These are from one or other of two horizons, from the carboniferous and from the pleistocene. They are from various localities and, as noted, of wide-sundered geologic age. Only those collected in Iowa are presented at this time.

Araucarioxylon occidentale Macbr., n. s. Plates VII, VIII.

Our first species is represented by certain large stump-like masses of petrified wood from Van Buren county. Plate VII, Fig. 1. These great masses, from forty to fifty centimeters in either diameter, show at sight their origin and are instantly recognized as petrified wood. The specimens occur detached and free upon banks and bottoms of watercourses and have been, evidently, long exposed to weathering. As a result the silicified layers of wood are liable to separate from each other, and nowhere yield the clearest sort of microscopic sections. Nevertheless, as shown by Plates VII–VIII, legible structures have been obtained. We have to do with a conifer, apparently, with large pith; with distinct lines of growth; without resin ducts, or at least with few; with bordered pits in single or double series upon the radial faces of the elongate cells or tracheides (Plate VII, Fig. 2), the pits closely placed but not mutually interfering. For these reasons we refer the material to the genus *Araucarioxylon* Kraus. The small bordered pits in single or double rows, with apparently elongate openings, suggest the structure of no ordinary conifer and emphasize the uncertainty of all our reference in absence of facts other than those largely by the microscope revealed.

The fossils before us, then, show the usual tracheides quadratic in transverse section with an average diameter of 22μ . These are furnished on the radial sides with small bordered pits, more often

in single rows, along the middle of the face, sometimes in double rows, closely placed but not compressed, in diameter about one-fourth the width of cell. The pit or opening is, as stated, slit-like or oval and the two openings on opposite sides of the tracheide wall appear to have been transverse to each other. An occasional pit appears on the tangential face of the cell. In transverse section the pits show the usual figure as seen in recent forms.

On sections of the material uncertain lines of growth appear, or at least the rock tends to split in concentric fashion. The concentric plates are remarkable for their thickness, being from seven to eight ^{mm} broad. Under the microscope the line of growth is not always distinguishable, owing to the irregularity of the silicification. Some sections, however, are sufficiently clear, Plate VIII, Fig. 1; the autumn-wood shows some modification, but less pronounced thickening. Possibly the difference shown in the fossil corresponds to the chemical rather than the physical condition of the wood replaced. There is no apparent reduction in the radial diameter of the tracheides nearest the line of growth-boundary, as is commonly the case in our recent woods.

The medullary rays are composed of simple parenchyma cells, quadrate, rather long, extending across four to seven tracheides or more, showing in the sections at hand no pits or openings of any kind. Seen in tangential section the medullary rays appear as simple vertical cell-rows, Plate VIII, Fig. 2, occasionally, but rarely, two cells in width, but in such cases only for a short distance. The number in a section is variable, from six to twenty. No resin ducts have been discovered in any of the many sections studied, and we presume their absence.

Our material is from weathered slopes representing the exposures of the Des Moines stage of the Upper Carboniferous, Van Buren county, Iowa.

In connection with those palæozoic stems it is proper to place upon record one other fragment interesting for what it records rather than for its own identity. In Plate IX, Figs. 1-2, we show views of a bit of drift from the Wisconsin or most recent glacial deposits of Northwest Iowa. Its history is inferable only from what we learn from other sources. Here we have a piece of exogenous material, a piece of an exogenous trunk perforated in

almost every part by the borings of some old-time *Teredo*. The specimen is so cut to pieces by the borings, now filled up, of course, that a fair section of the wood is with difficulty obtained. From the fact that Cretaceous rocks lie in the pathway of the ice-sheet that brought us the drift, and the further fact that the upper Cretaceous deposits are everywhere full of dicotyledonous fossils, we are led to the conclusion that our fossil is probably of the age named. *Teredines* are found fossil in the Old World from the Jurassic up.

In our fossil the laminated substance of the shell is shown in several sections.

PLEISTOCENE STEMS.

CONIFERALES.

Picea mariana (Miller) Britt. Plate X.

In our collection are a great number of specimens of wood from the forest bed found in Iowa everywhere, usually immediately beneath the blue clay. These wood-fragments are generally well preserved, so much so that microscopic sections are easily made and microscopic structures easily observed. Such examination, so far, has brought to light coniferous wood, and coniferous wood only. In the absence of foliage and fruit our determination of even these almost modern materials is attended with some uncertainty. Some of the fragments have been referred to *Larix laricina*, others to *Picea mariana*, *P. nigra* auctor., the common black spruce of our northern coniferous forest.

Our present specimens are cones about one inch in length and about one-third of an inch in diameter; one with the scales slightly expanded, the other closed as prior to seed-dispersal. Whether the latter contain seed has not been determined,—cannot be without destroying the fossil. Accompanying the cones were found bits of wood. These, however, represent the following named species.

Our illustration, Plate X, Fig. 1, shows the cones above mentioned about twice natural size, from beneath the Kansan drift, in Washington county, Iowa.

Picea canadensis B. S. & P. Plates X, XI.

The fine block of fossil wood shown in our Plate X, Fig. 2, is from the base of the blue clay near What Cheer, Keokuk county.

The wood has fairly well resisted decay, is strongly impregnated with ferrous sulphide, in some parts carbonized so that it breaks with smooth black fracture and resembles lignite. In other parts the tracheides, especially in the neighborhood of the spring wood, show evidence of crushing and the structure is largely obscured. But in some places the cell-walls are almost perfect and sections are entirely satisfactory.

The specimen represents a stem which must have been originally twenty or thirty centimeters in thickness. At present the fragment is twenty-five centimeters long, about eight centimeters in the shorter, about twelve centimeters in one-half of the longer diameter; the block in this direction is imperfect and incomplete.

The identification here proposed is based wholly upon the microscopic structure of the wood. In Plate XI, Figs. 1 and 2, this is shown in the upper figure contrasted or compared with the figure of a corresponding section made from the fresh wood of the species as now grown by cultivation in Iowa. The correspondence of structure is, it is thought, remarkable. The microscopic sections suggest an identity even more exact than the illustration shows. The peculiar oblique or spiral striæ which mark the wall of the tracheide and which leave their trace upon our plate illustrating the fossil, are distinguishable in microscopic sections of recent wood, but do not come out very plainly in our photographic print. It must be noted too that these spiral markings appear equally distinct on the tracheides of *Picea abies* (L.) Kars-ten, as we have learned by comparison of material grown in Iowa. In fact the two species of modern spruce named may, by the microscope, only with difficulty be distinguished. We have referred the fossil to the one species rather than the other simply because *P. canadensis* is still a habitant of North American forests, while *P. abies* is not, and if it ever was, which is certainly by no means improbable, it is hard to see why the approach and recession of the ice-sheets should have brought it to total extinction. Our reference to the existent species is more plausible, even although the microscopic evidence inclines rather to the European form. Plate XII, Figs. 1 and 2, shows further the microscopic structure of this fossil spruce, in sections transverse and radial.

EXPLANATION OF PLATE I.

Figure 1.—Radial view of specimen *B* of *Sigillaria calvini*. The remains of the cortex appear above and the medullary cleavage of the wood appears clearly shown.

Figure 2.—Tangential view of specimen *C*, *Sigillaria calvini*. A small fragment of cortical structure appears at the upper left hand corner of the figure; in the middle we have the natural (?) outer surface of the wood-cylinder, showing obscure *Sigillaria* imprints; next the inner surface of an arc of secondary wood, and at the bottom the outer surface of a similar corresponding arc of primary wood. Note that the fluted or channeled appearance is due to the crenulate or wavy line of separation between the primary and secondary wood. See Plate V, Fig. 2.

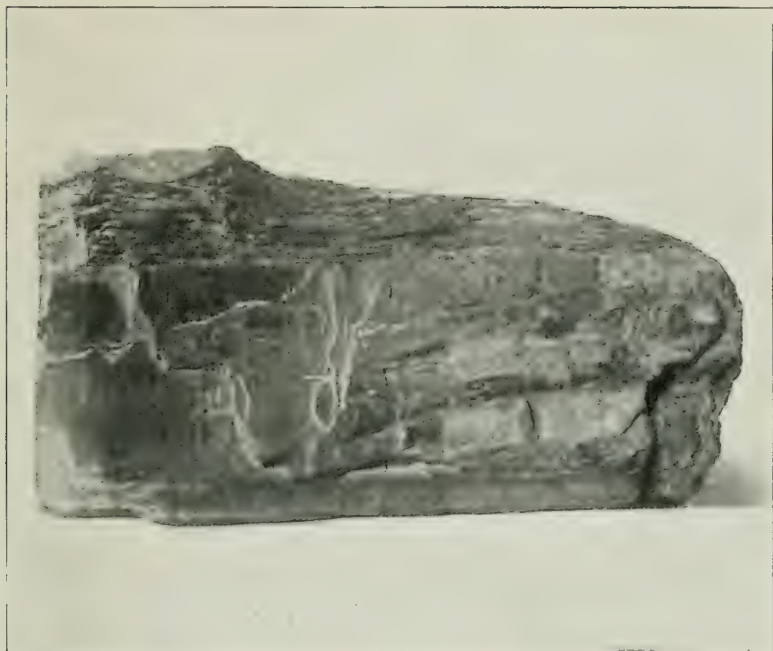


Fig. 1

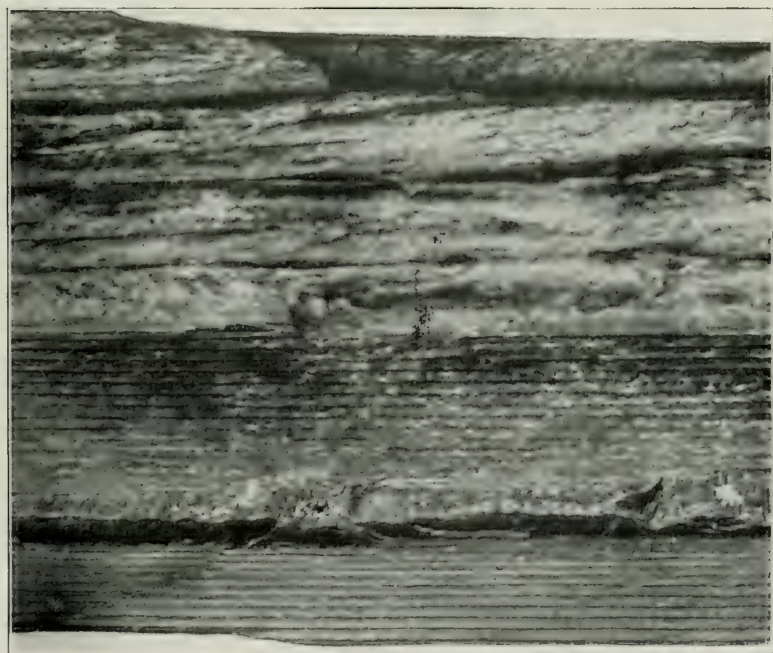


Fig. 2

EXPLANATION OF PLATE II.

Figure 1.—A transverse section of one portion of the compressed wood cylinder, primary wood only, *Sigillaria calvini*, magnified about 30 diameters. The pith has been entirely supplanted by silicious deposits. The crushed cells are to be noted at the extreme left of the figure.

Figure 2.—A transverse section of secondary wood of the same species, $\times 100$. The medullary rays are here conspicuous.

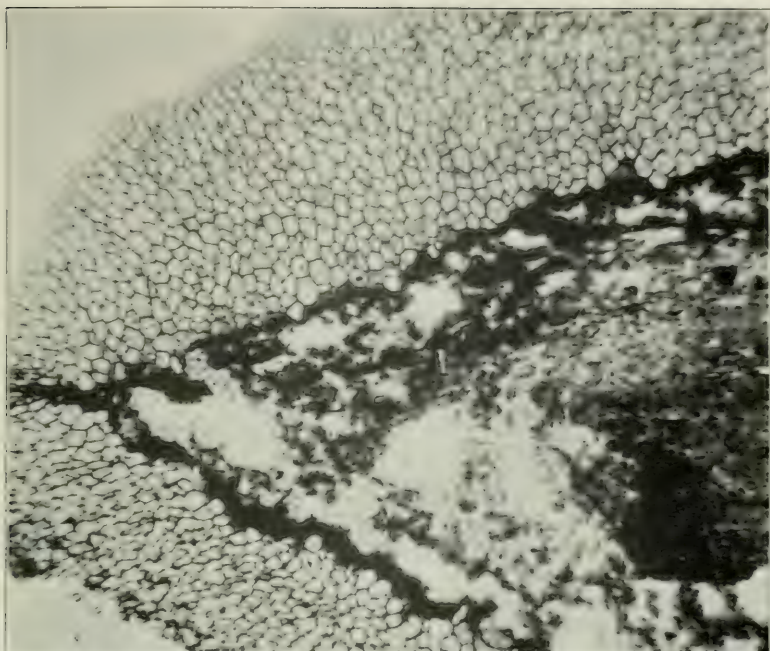


Fig. 1

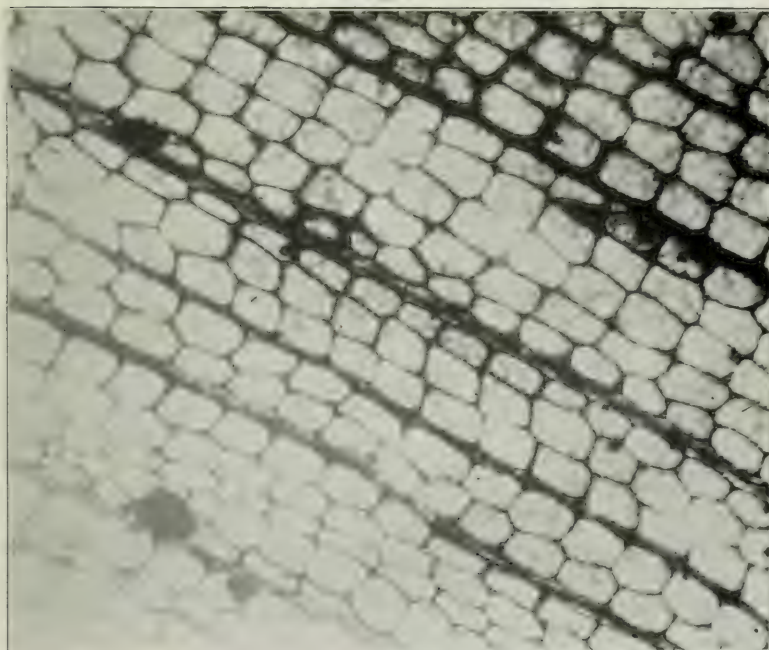


Fig. 2

EXPLANATION OF PLATE III.

Figure 1.—Radial section of *Sigillaria calvini*. The figure is made to show the comparative breadth of the medullary rays.

Figure 2.—Tangential section of wood of the same species to show the irregularity and imperfections of the whole medullary system.

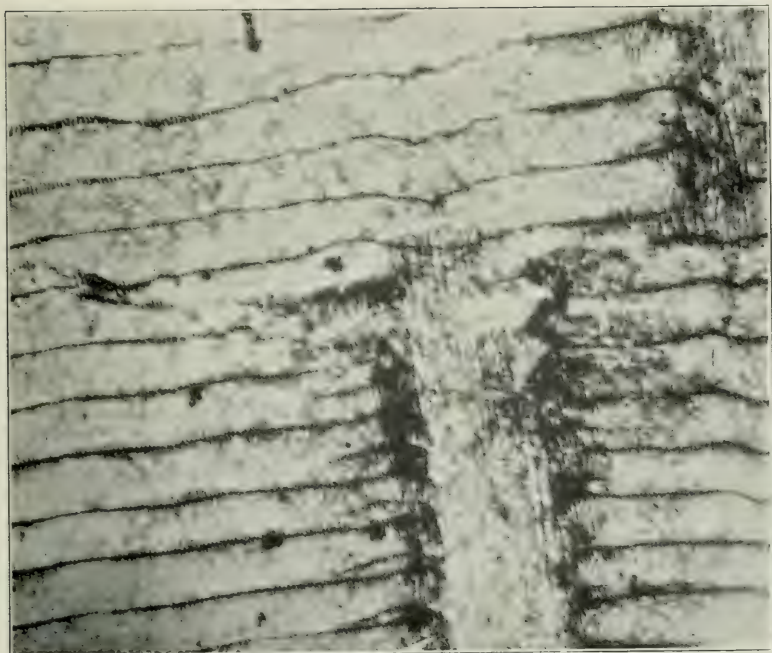


Fig. 1

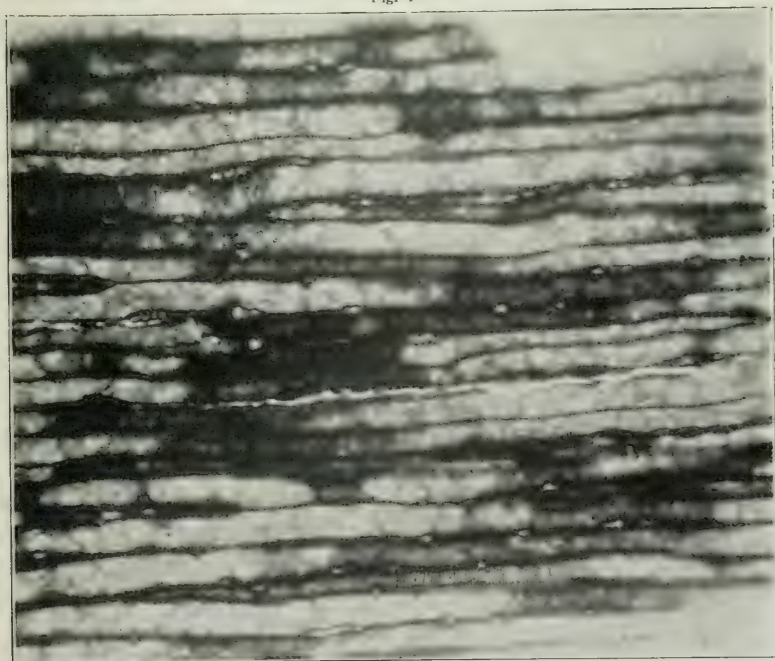


Fig. 2

EXPLANATION OF PLATE IV.

Figure 1.—Transverse section of the fragment of *Sigillaria calvini* shown in Plate I, Figure 1. The section was made in an attempt to show the cortex structure. A piece of the secondary wood has slipped in the preparation so as to obscure the structure in part. In the upper part of the figure the contact of wood and cortex is shown.

Figure 2.—Transverse section of the fragment of the same material shown on Plate I, Figure 2. Here the primary and secondary wood rings appear in more or less exact contact, showing apparently the merismatic cells from which the secondary tracheides are developed.

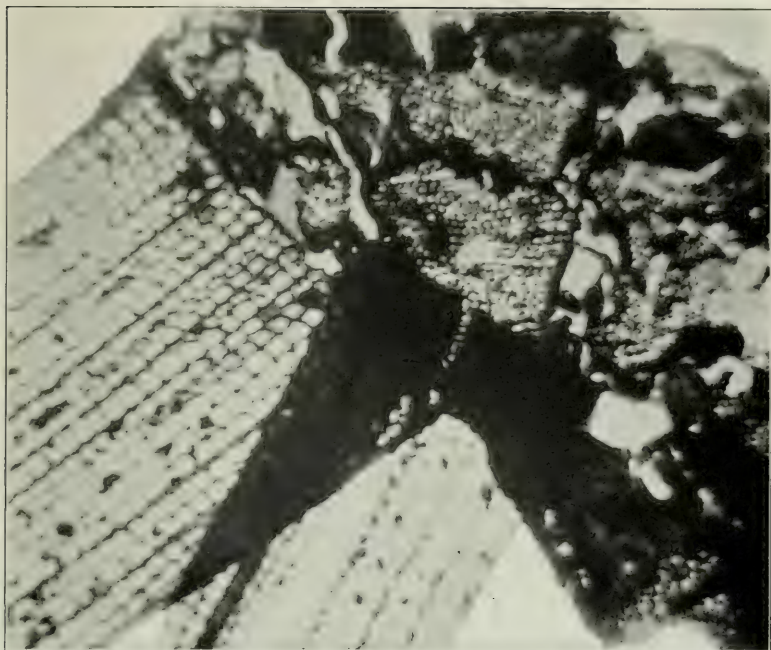


Fig. 1

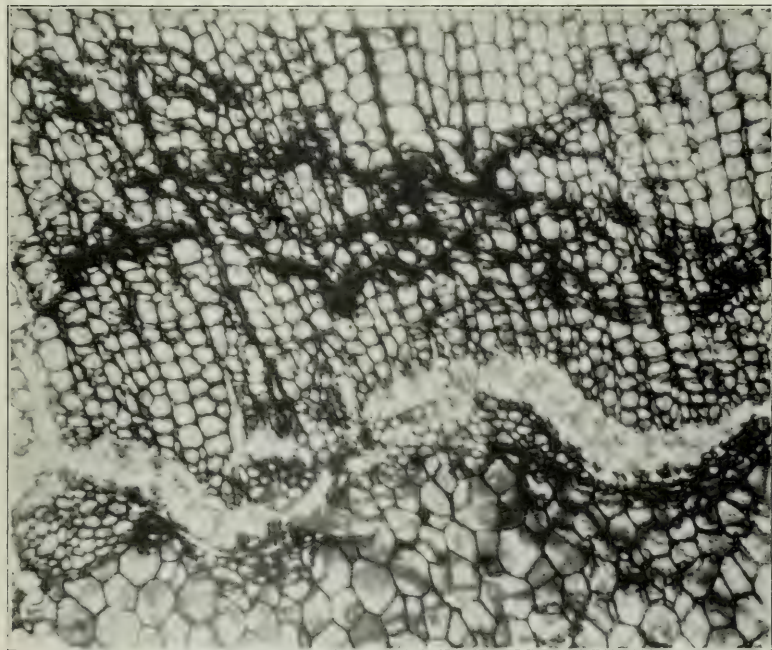


Fig. 2

EXPLANATION OF PLATE V.

Figure 1.—End-view of a fragment of *Psaronius borealis*. To the left are shown the peculiar vascular bands, arcuate and involved; to the right the peculiar cortex characteristic of the genus.

Figure 2.—Tangential view of the same specimen. The peculiar vascular thread-like descending roots are fairly shown.



Fig. 1

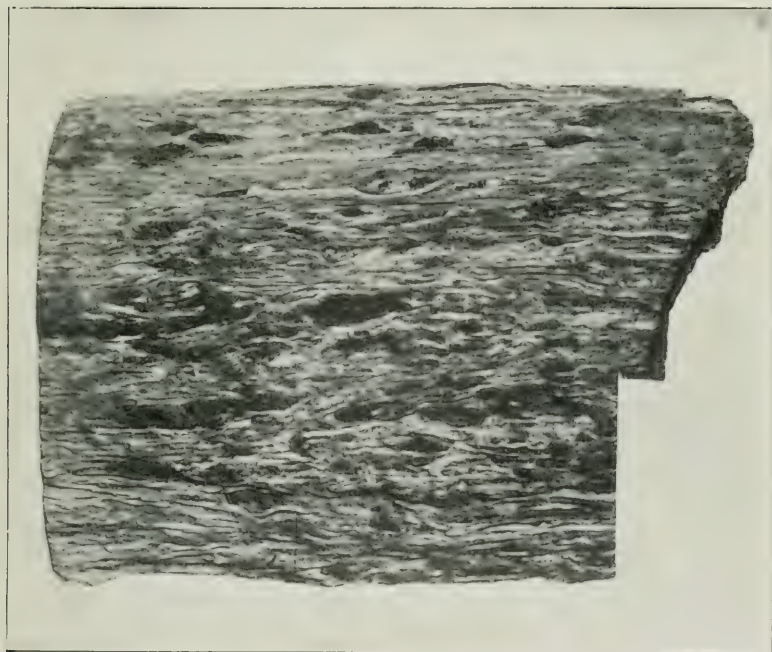


Fig. 2

EXPLANATION OF PLATE VI.

Figure 1.—A transverse section of a fragment of *Psaronius borealis*. The section shows, at the lower left hand corner, tracheæ in the center of the bundle.

Figure 2.—A similar section of the same fragment to illustrate the general structure. Five bundles are shown nearly entire; between these, extending transversely across the figure, is the ordinary modified parenchyma, forming here the fundamental tissue of the stem. The sclerenchymatous bundle sheaths are well shown, much as in the case of the bundle of a modern endogen.

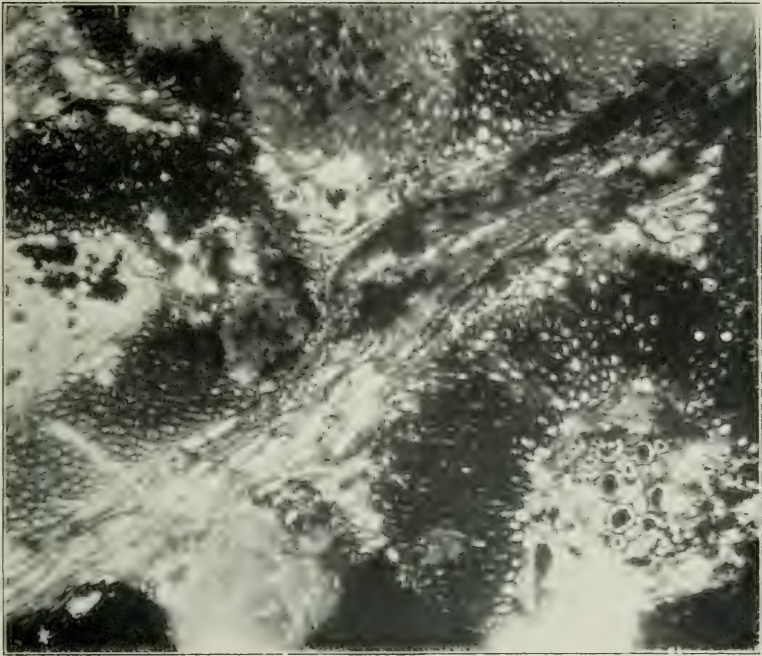


Fig. 1

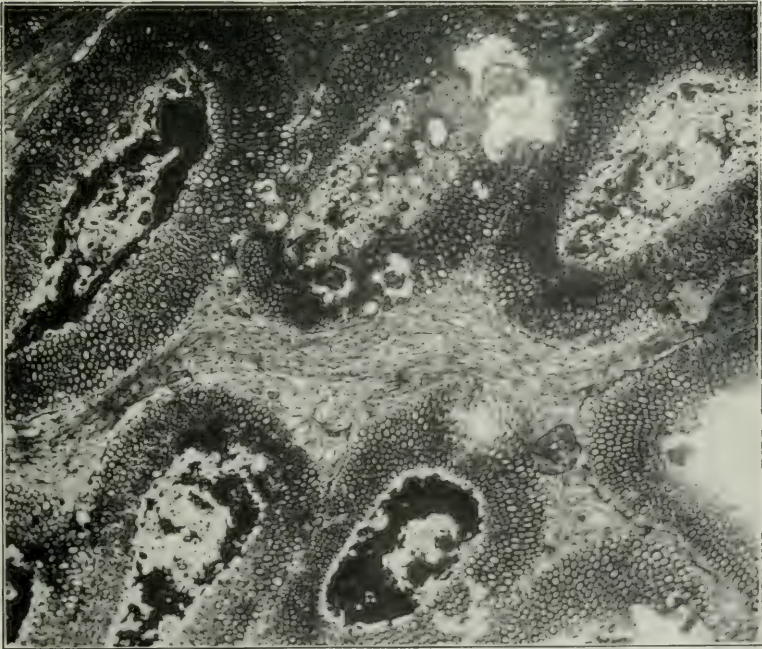


Fig. 2

EXPLANATION OF PLATE VII.

Figure 1.—Stump of *Araucarioxylon occidentale*, $\times \frac{1}{10}$.

Figure 2—Longitudinal, radial section of the silicified wood of the species figured above. Medullary rays appear at the left.



Fig. 1

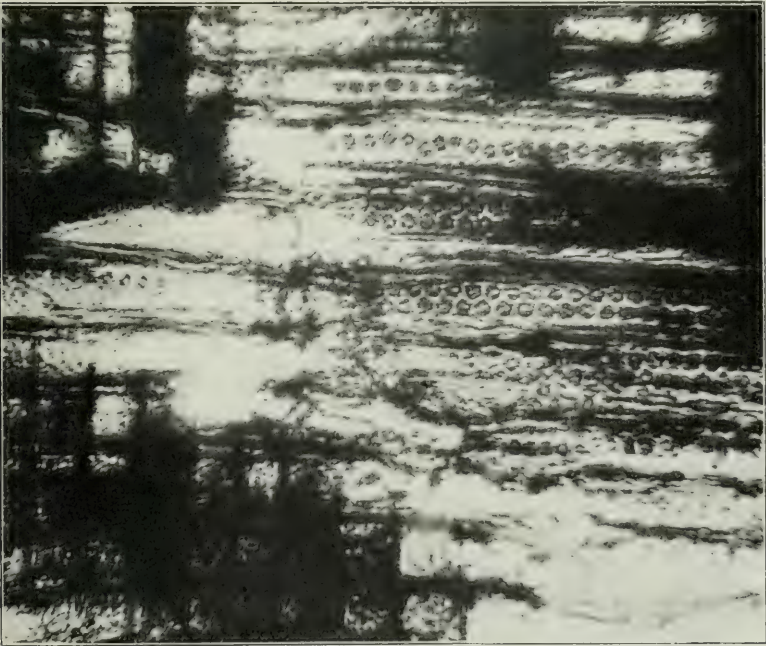


Fig. 2

EXPLANATION OF PLATE VIII.

Figure 1.—Transverse section of *Araucarioxylon occidentale*. The section shows a line of growth (so assumed) extending vertically almost in the middle of the plate.

Figure 2.—Tangential section of the same material to show the distribution and height (measured in superimposed cells) of the medullary rays.

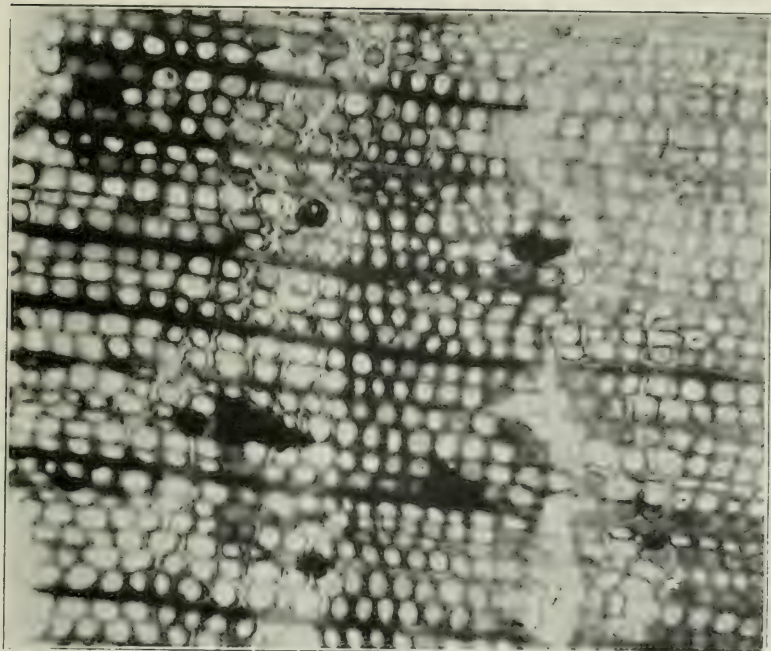


Fig. 1

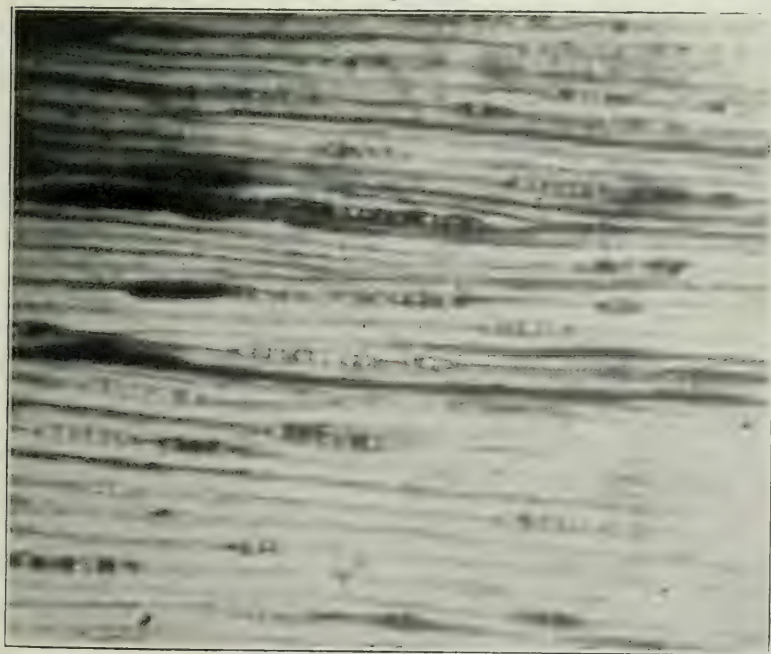


Fig. 2

EXPLANATION OF PLATE IX.

Figure 1.—Silicified block of some deciduous tree, almost entirely consumed by teredos prior to silicification. About one-half natural size.

Figure 2.—Fragment of the same block showing the toredo burrows in cross-section.



Fig. 1



Fig. 2

EXPLANATION OF PLATE X.

Figure 1.—Two cones of *Picea mariana* from below the blue clay. The figures are shown about twice the natural size.

Figure 2.—A fragment of wood from beneath the blue clay. The fragment is referred to *Picea canadensis*. The figure is about one-half natural size.



Fig. 1



Fig. 2

EXPLANATION OF PLATE XI.

Figure 1.—Tangential section of the wood of the fragment shown on Plate X, Figure 2. The section of a resin passage occupies the center, and the striæ of the tracheides come out well in all parts of the section.

Figure 2.—A corresponding section of recent wood, *Picea canadensis*, introduced for comparison. The striæ on the tracheides are less distinctly shown in the fresh unstained wood as here.

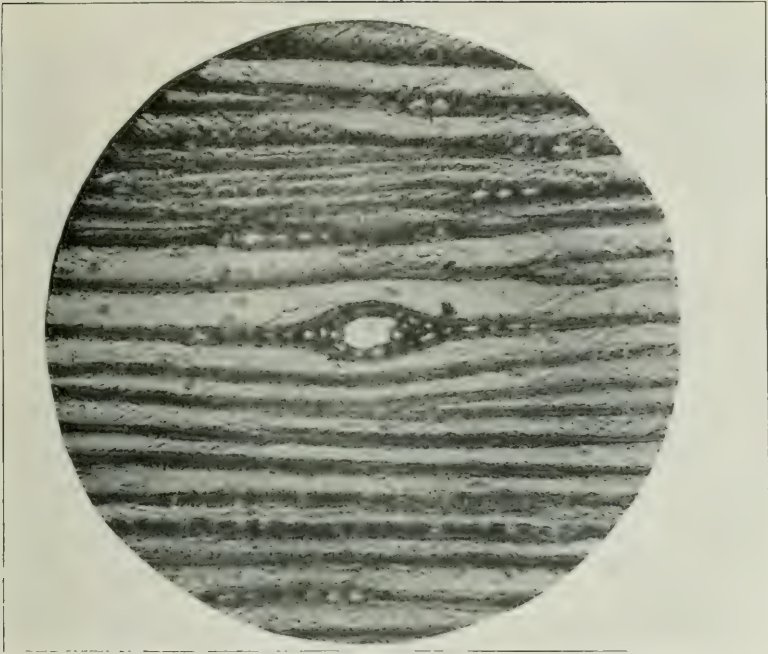


Fig. 1

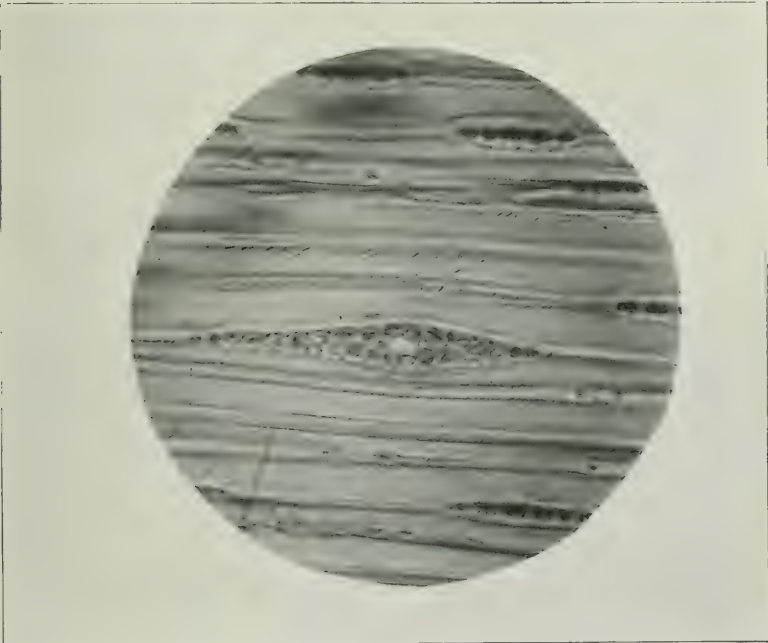


Fig. 2

EXPLANATION OF PLATE XII.

Figure 1.—Transverse section of *Picea canadensis* from the so-called "forest-bed" beneath the blue clay. The section shows three resin-ducts.

Figure 2.—Radial section of the same material cut so as to show the bordered pits.

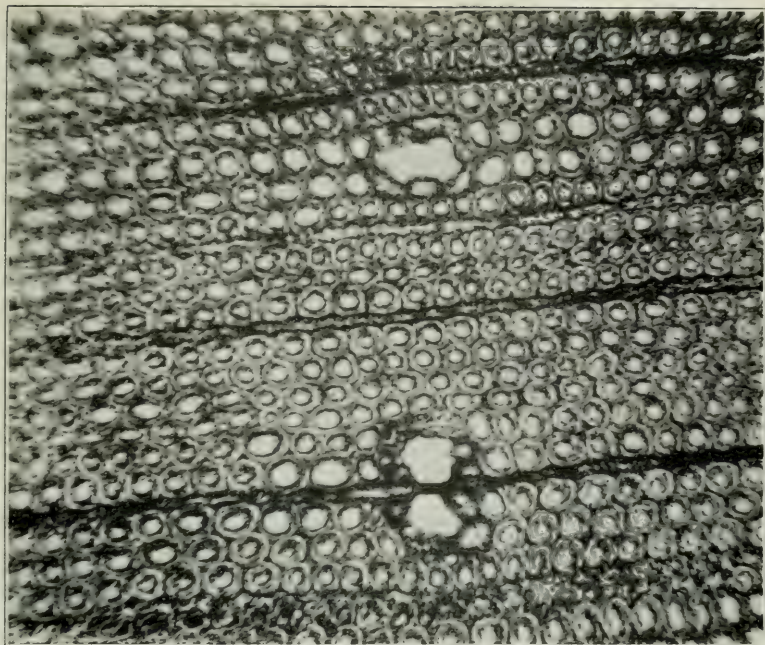


Fig. 1



Fig. 2



DESCRIPTIONS OF NEW FORMS OF JASSIDAE

HERBERT OSBORN

DORYCEPHALUS PUTNAMI n. sp.

Black, head produced but shorter than other species of the genus, longer than width between the eyes, margins very thin, elytra long, extending almost to tip of pygofer; length, male, 5^{mm}.

Head much less produced than in *platyrhynchus*, narrowed to a rather broadly rounded apex, margin thin, foliaceous, slightly upturned, becoming somewhat spoon-shaped at apex; the surface of the vertex rather distinctly marked with longitudinal rugosities. Eyes elongate, extending about half their length on margin of pro-thorax, ocelli on margin between vertex and front and close to the compound eyes; front somewhat tumid, becoming carinate where it merges into the vertex, flattened at base of clypeus; the sutures converging sharply from antennal sockets; loræ widening apically, nearly reaching margin of the cheek; clypeus with parallel sides, apex reflexed and very slightly expanded. Pro-thorax shorter than vertex, wider than long, with a distinct median carina reaching nearly to the hind border; the surface strongly punctate and, posteriorly, with transverse rugæ; scutellum punctate, faintly rugose. Central transverse impression distinct and two fainter longitudinal impressions. Elytra scarcely reaching tip of abdomen, opaque, faintly and minutely punctate, inner claval vein joining the outer near its tip.

Color.—Black throughout.

Genitalia.—Male valve short with an obtuse angle behind; plates as wide as valve at the base, the outer margins sinuate, the apices acute, reaching about two-thirds the length of the pygofer. Pygofer conical, opening posteriorly, obliquely truncate.

Described from two specimens, males, one from Chester, Ga., from the Georgia State Collection through the kindness of Mr. Wilmon Newell; the other from Jacksonville, Fla., collected by

Mrs. Annie Trumbull Slosson and kindly loaned to me by Prof. E. D. Ball. This is an interesting addition to this genus, differing in shorter head and black color from our previously known species and occupying a new range; hitherto no species has been recognized in our southeastern fauna. I take pleasure in naming it in honor of Mrs. Mary L. D. Putnam who, during her lifetime, did so much for the encouragement of science, especially in Entomology.

DELTOCEPHALUS SANDERSI n. sp.

Gray with black points on apex of vertex, disc of clavus and corium and black border to reflexed costal veins. Face dusky, gradually paling below. Length, female, 3.55^{mm.}, male, 3^{mm.}.

Head acutely produced, rounded at extreme apex, vertex about one and one-half times as long as broad, flattened front broad and prominent. Clypeus narrowing to truncate apex, loræ rather small, borders of cheeks nearly straight. Pronotum distinctly truncate behind, lateral margins extremely short, forward costal veins sharply reflexed.

Color.—Ashy gray, a quadrate spot including a white dot on apex of vertex, an oblique spot on clavus and at base of discal cell, hinder edge of reflexed veins and border of central apical cell black, face dusky above with five or six light arcs becoming paler on lower portion; beneath and legs uniformly gray with black points at tip of hind tibiæ, bases of tibial spines and a band on the hind tarsi blackish.

Genitalia.—Female ventral segment short with a central produced rounded lobe with a black border; pygofer, short, thick, dusky with whitish points from which arise short, stiff, blackish hairs. Male valve triangular, posterior border slightly acuminate, plates broad at base, narrowing sharply, produced apically, slightly divergent, acute at tip, scarcely twice as long as valve, about two-thirds as long as pygofer.

Two specimens, one male and one female, from Ch. Bridge, Va., collected by Mr. J. G. Sanders, and two specimens, one male and one female, the latter with upper half of face darker than other specimens, collected at Monticello, Ga., by H. S. G. Titus. This species resembles *flevuosus* Ball in general appearance but differs decidedly in genitalia of both male and female. I take the liberty

to name it in honor of my friend and former student, Mr. J. G. Sanders, who has added many interesting specimens in this group.

A somewhat larger specimen, similarly marked above, but with the face almost entirely black with very faint indications of light arcs, and under side of abdomen black, collected at Hyattsville, Md., by Prof. J. S. Hine, is also referred here.

DELTOCEPHALUS PICTUS n. sp.

Grayish, marked with lighter lines, head strongly produced, elytra with reflexed veins, upper half of face black, lower half yellow. Length of male, 3^{mm.}

Head produced, vertex about one and one-half times as long as broad, nearly flat, front broad, margins nearly straight, converging towards base of clypeus. Clypeus slightly longer than broad, tapering slightly toward rounded apex, cheeks nearly triangular, loræ rather broad, outer border semi-circular, margins of genæ almost straight. Pronotum with hind border straight, lateral margins very short. Elytra reaching nearly to tip of abdomen, three costal cross-veins reflexed, central anteapical cell constricted but not meeting at middle.

Color.—Gray, vertex with a black spot at apex including light yellow dot at tip, transverse fuscus band half way from apex to border of eyes, a darker transverse narrow band or line even with front border of eyes and two dusky stripes from near the center of each lateral area of the disc, connecting with similar colored bands on the pronotum, central impressed line distinctly marked, and black. Eyes gray, front black down to level of the eyes, with clypeus, loræ and cheeks light lemon yellow; scutellum with four dark dots on disc and faint fuscus stripe near lateral angle; elytral veins whitish, the borders on apical half strongly bordered with fuscus or blackish, and a rather distinct blackish spot at apex; beneath blackish with margins of thoracic and abdominal segments narrowly yellow, loræ and base of anterior femora blackish, remainder of legs yellowish with dusky spines and claws.

Genitalia.—Male valve short, transverse, plates broad at base, tapering uniformly to rather blunt point; pygofer very long, more than twice the length of plates, converging apically and passing the tip of elytra.

Described from one specimen collected on Staten Island, N. Y.

It is a very striking species and although only a single specimen is in hand it seems desirable to describe it.

THAMNOTETTIX BRITTONI n. sp.

Resembles *kennicotti* but narrower, somewhat lighter, markings of prothorax and elytra, especially in the male, less distinct. Length, female, 5.75^{mm.}, male, 5^{mm.}.

Vertex subangulate, about one and one-third as long at middle as at eye, transversely depressed on the disc, rounded over to front; front nearly twice as long as broad, with two round black points between the ocelli, tapering to clypeus; clypeus narrow, widening slightly to apical third; loræ extended, touching the margin; pronotum faintly, transversely striate, polished, posterior border almost straight; elytra translucent.

Color.—Fulvous brown, males a brighter golden fulvous, with yellow markings less pronounced. Female, with front of vertex, most of face, transverse band on the pronotum, prominent claval stripe from near the base to apical cells and body beneath the legs, yellow; elytral veins pallid; venter somewhat more golden yellow and sutural lines touched with sanguineous. In the male the yellow markings are very faint, the whole body suffused with golden fulvous. The two prominent round black spots between ocelli, on border between vertex and front, are perfectly visible from above.

Genitalia.—Last ventral segment of female nearly twice as long as the preceding; hind border rounded, slightly thickened at the middle, forming a slight and faintly notched median lobe which is slightly embrowned laterally. Male valve very short, plates broad at base, margins curving to form narrowed, acuminate tips reaching nearly to end of pygofer; border finely ciliate.

Described from one female and three male specimens received from Prof. W. E. Britton, New Haven, Conn., to whom I take pleasure in dedicating the species. Of these, one was collected by W. E. Britton, July 15, 1904; one by B. H. Welden and one by W. E. Britton, July 20, 1904; one by H. L. Viereck, July 6, 1904. The species bears a striking resemblance to *kennicotti*, but aside from smaller size and narrower body, has lighter color and lacks the black markings of the pleuræ and has a shorter female ventral segment.

THE FUNCTION OF THE PROVINCIAL MUSEUM.

C. C. NUTTING.

If the psychologists are correct when they tell us that civilized man is "eye-minded," it follows as a natural sequence that the easiest way to educate in regard to concrete objects is through the eye. While it is doubtless true that we have been influenced largely in the direction of eye-mindedness by the prevalent habit of reading, a habit which leads to a discrimination of small differences in form, it still remains a fact that the most direct and common appeal to the intellect is through the eye, and that we remember largely in terms of vision.

Thus it comes about that the two most important agencies in popular education are intended to appeal to the consciousness directly through the eye. These agencies are the library and the museum.

An enormous impetus has been given to the former through the princely and wise munificence of a single man, Mr. Carnegie, and the time will come when the importance of the second, the museum, will be recognized as widely as that of the library is at present.

Dr. Edward S. Morse, Director of the Peabody Academy of Sciences, has published a paper with the significant title, "If Public Libraries, Why Not Public Museums?" from which I quote the following:

"Lessons from books, and not from nature, have been the tiresome lot of school children. Questions and answers, cut and dried, have tended to deaden the enquiring spirit. That portion of the child's brain which is involved in observation has been reduced to atrophy by the usual public school methods." "I shall never forget the bitter disappointment I felt as a boy, on my first journey, when the stage driver pointed out to me with his whip the dividing line between the states of Maine and New

Hampshire. There was no colored line! There was no change in the color surfaces of the two sides! I felt grieved and rebellious at the imposition that had been practiced upon me." "The book method of education has almost paralyzed public desire for museums, and the result has been that the museum, when instituted, has been in the interest of specialists, and mainly through their efforts."

The museum, then, is an educational force that cannot be neglected. It should be regarded as of coördinate value with the library. This does not mean that it can ever supplant the latter, but that it can be its most effective supplement and aid, as Professor Goode, the ablest museum organizer that this country has ever produced, points out in the following words:

"I am confident, also, that a museum, wisely organized and properly arranged, is certain to benefit the library near which it stands in many ways through its power to stimulate interest in books, thus increasing the general popularity of the library and enlarging its endowment."

The meaning of "provincial museum," as used in the title of the present paper, needs some explanation. Museums may be classified in various ways. For instance, they are most commonly distinguished by their main contents, as Art Museums, Natural History Museums, Historical Museums, Commercial Museums, etc. On the other hand they can be classified in accordance with the power by which they are owned or controlled. This gives rise to the National Museum, owned and governed by the Nation. This should be, but often is not, the most dignified and comprehensive of all museums. In our country, however, there are at least three museums that are, or soon will be, much more extensive than the National Museum at Washington, even when the latter is installed in the proposed new building.¹

Then there is what may be designated as the Metropolitan Museum, situated in a great city and controlled neither by the Government nor by a college or university. In this class would come the Carnegie Museum at Pittsburg and the Field Colum-

1. Reference is made here to the American Museum at New York, the Carnegie Museum at Pittsburg, and the Field Columbian Museum at Chicago, each of which has buildings planned or already erected that will more than double that of the proposed new National Museum in capacity, and each of which is more munificently endowed than the latter.

bian Museum at Chicago. The American Museum in New York City is practically in the same class, but its connection with Columbia University excludes it from this group on technical grounds. These three institutions are, or soon will be, among the foremost in the world in point of size and endowment.

Again, we have the University Museum, such as that at Oxford or Cambridge in England and Harvard or Yale in this country, the primary function of which is to aid in the education of the college man, thus differing fundamentally from that of the National or Metropolitan Museum.

Lastly, we have the class which furnishes the subject for this paper—the Provincial Museum. The term is used in a not very exact sense, but is intended to include all of the public museums that are neither national, metropolitan nor university museums as defined above. Such institutions are necessarily more limited in scope than either of the other classes because they are not backed by the resources of a nation, a great city, or a university. They are limited in number in this country and have not as yet secured the public support that their real importance should command. In England there are a number of such institutions supported by public funds, and many of them are doing a work creditable to themselves and of recognized utility to the public. The "Hancock Museum" at Newcastle-on-Tyne is an example of a thoroughly dignified and useful museum of this sort. It is not large. Indeed, as I remember it, it is not very much larger than the Davenport Academy of Sciences Museum, but it contains much that is of very unusual interest, and its scope is almost exactly that which I am about to indicate as the ideal one for such an institution.

One has to look in vain for such a museum in our central states, the nearest approach to it being our own museum at Davenport. But the time is coming when such institutions will rank in aggregate importance with either of the other classes enumerated above.

In a report made by a committee to the British Association for the Advancement of Science, the following are set forth as the special objects of the Provincial Museum¹ of the United Kingdom:

"1. To contribute its share to the general scientific statistics

¹ Report of the United States National Museum for 1893, p. 777.

of the country by collecting and preserving specimens of the natural and artificial productions of the district in which it is situated.

"2. To procure such other specimens as may be desirable for illustrating the general principles of science, and the relation of the locality to the rest of the world.

"3. To receive and preserve local collections or single specimens having any scientific value which the possessors may desire to devote to public use.

"4. So to arrange and display specimens collected as to afford the greatest amount of popular instruction consistent with their safe preservation and accessibility as objects of scientific study.

"5. To render special assistance to local students and teachers of science."

According to the views of the present writer, the functions of the provincial museum, as defined in this paper, are:

First. The securing of as complete a local collection as can possibly be obtained. This should, it appears to me, be the primary object of the institution. Ordinarily, however, it is the very last thing to engage the attention of the bodies governing such museums. The idea that we must ransack foreign countries for museum material of first-class value is a fundamental mistake. The primary object of the museum is the education of the people; and a complete, well-displayed and well-labeled series of the local fauna, flora and minerals will stimulate interest and impart information more quickly and surely than any other means.

It is a mistake to think that the people are not interested in familiar things. On the contrary there are no specimens that are more attractive to the average child or adult than the birds and flowers and insects familiar to him. Such specimens are a more welcome sight than those from foreign localities for the same reason that familiar human friends are more appreciated than strangers. A somewhat long and extended acquaintance with the public in its relation to a natural history museum has brought conviction of this fact to the writer, and any one who lingers long in a museum and watches the visitors will be inevitably forced to the same conclusion.¹

¹ The writer would not have it inferred that he would exclude general collections from the provincial museum. On the contrary, the local series should be the nucleus

But it is not enough to have our local collection installed and displayed in the ordinary way, the specimens arranged in stiff rows, with equally stiff labels giving the technical names and localities, with, perhaps, the name of the donor.

Dr. F. A. Bather, in a paper with the somewhat whimsical title, "How May Museums Best Retard the Advance of Science?" says:

"None of us but has been taught how to bewilder the eyes of the public with thirty specimens of an object, all placed the same way up, and displaying as few of its essential characters as possible, when one specimen properly labeled would have sufficed. We know how to strike dullness through the hearts of thousands by our funereal rows of stuffed birds with their melancholy lines of Latin names."

The installation of collections has become a real art in modern museums, and nowhere has there been more striking advance than in the manner of showing to the public the things that we want it to see. The amount of thought and effort that has been devoted to this purpose has brought more reward to the conscientious curator than any other part of his work. The visitor merely feels that the effect is pleasing or tiresome, as the case may be, but does not realize that the difference between pleasing and tiresome is almost always and surely a difference in the method of installation. This has assumed the dignity of an art of recent years, and the most painstaking attention is given to such matters as background, illumination, cases, accessories and labels.

As regards the very important subject of labels, Professor G. Brown Goode has said: "An efficient educational museum may be described as a collection of instructive labels, each illustrated by a well-selected specimen."

In general it may be said that the aim of the provincial museum should be to install its specimens in such a way that the visitor will be pleased and not wearied, and that certain definite facts will be taught thoroughly and impressively. For example: The collection of birds should not be limited to a systematic series in monotonous rows, but should enforce the life history of a number

around which should gather typical specimens illustrating the relationships of the local material to that of the world at large. The local collections should, however, make a serious attempt at completeness, while the exotic material must necessarily be fragmentary, at least in comparison.

of familiar forms in such a way that the merest child can not fail to understand and appreciate it. Not only the adult form should be exhibited, but the young, the nest, and the eggs. If possible these should be combined in an artistic group that will be, above all things, correct in every detail. Then the label should tell the story simply and clearly. If the species is of either positive or negative economic importance, this fact should be stated together with the most effective means of encouraging the birds if of economic value, or of destroying them if harmful. Fortunately the latter will seldom be the case.

In addition to these concrete lessons, the museum can and should teach much regarding the general laws of nature. For instance, such matters as protective coloration, mimicry, geographical distribution, variation, etc., can be very effectively illustrated by definite examples taken from the familiar woods and fields.

Second. The securing and exhibition of a notable collection in some one field of science. In other words, some special "hobby" should find a place in every museum of any pretension.

Just what this special collection will be in any particular instance is more often determined by accident than design. The original curator of the institution may have been a specialist in some limited field, and hence the collection is fore-ordained to be built up in that particular direction. Again, it often happens that the founder of the museum has long been interested in gathering together material in some one field, and has donated this collection as a nucleus for the future museum.

In the case of the museum of the Davenport Academy there are two collections of special value—namely: The entomological collection, contributed by Mr. J. Duncan Putnam, and the very valuable anthropological collection, mainly from eastern Iowa and western Illinois, which can be regarded as almost unique in its scientific value. This latter seems destined to be the collection par excellence which will be forever associated with this very creditable museum; and it is, in my opinion, the feature that should be most energetically pushed and endowed by those in charge of the Academy. This collection should be jealously guarded and effectively displayed, and no effort should be omitted that will tend to add to its treasures or increase its efficiency.

Third. Our ideal provincial museum having decided on the policy of securing a good local collection and seeing that it is installed and exhibited in a pleasing and adequate manner, and having further decided energetically to pursue the plan of keeping up some special hobby, should see to it that the necessary accompaniment of the museum, the library, should not be neglected. With the limited means usually at the disposal of the provincial museum, there should be no attempt at providing books for the use of the general public, although this is very desirable. Books of a technical nature, embracing those scientific fields covered by the collections, should be added as rapidly as possible, so that the specialist may find his tools ready at hand when he enters upon the study of the museum material. It will be necessarily a long and laborious task to provide a good working library, even in a few limited fields of scientific endeavor. It seems to the writer that nothing so clearly demonstrates the long-headed wisdom of the founders of the Davenport Academy as does their persistent work along the line of building up a good scientific library. There are very few such well-selected collections of scientific works in any provincial libraries in America, and not many in Europe.

I say that this policy is essentially far-sighted because it makes it possible for the institution itself to engage in the making of books and other scientific tools. It is altogether probable that no part of the endeavor of any soundly organized society pays more surely and more amply than the publication of its Proceedings and Reports. For this at once ranks a given institution among the solid and serious forces at work for the advancement of science, and secures a certain recognition among the world-wide sisterhood of similar institutions. This recognition is not by any means a purely sentimental one, but at once begins to prove its practical value in the tide of literature that sets toward the library of the favored Society or Academy, a tide that is ever on the increase and which goes far toward filling the empty shelves of the book room.

Fourth. Having spread the feast of good things for the public and for the special investigator, having provided attractively displayed collections and a good working library, the next thing for the museum administration is to see to it that the collections

are brought into vital touch with the public for which they are prepared. It is not enough to have certain days or certain hours during which the rooms are open to the general public, but special means must be taken to insure not a casual but an habitual attendance of the people. Care must be taken that the visitors depart with a sense of having been distinctly pleased rather than with a feeling of weariness that will inhibit habitual use of the museum.

Most of the remarks in the preceding pages concerning methods of attractive installation are directed toward the securing of the pleased attention of the visitor, but there are other means that the wise curator will not fail to use, and which in the Davenport Academy have already been used most effectively. I refer to the establishing of close relations with the public schools of the city and surrounding region. I know of no instance where this object has been more thoroughly and admirably attained than here. It will not do for a provincial museum to content itself with attracting to its halls the scientific specialists, nor even securing the passing interest of the casual visitor; but an intimate contact with the public, a contact which means real service, is essential to any lasting success. If the teachers and pupils of the public schools are once brought to the point that they feel that they are distinctly benefitted by the museum and can be kept to a realizing sense of that fact, a foundation is laid for reciprocal benefits.

This leads us directly to a vital question relating to the welfare of the provincial museum, and that is the question of public support in a concrete, that is, a financial way.

No museum or other public utility can hope to have a healthy growth unless it have a certain support upon which it can count in advance. In my opinion it would be no very difficult task to defend the thesis that a municipal or provincial museum should be supported by taxation, just as most city libraries are now supported. There is no question but that so good and well-managed a museum as that owned by the Davenport Academy of Sciences would, in almost any community in England, be regularly supported by a stated tax. Every argument that can be brought forward to defend the proposition that public libraries should be supported by funds raised by taxation is equally available in favor

of a like support for properly conducted museums. Such a museum should be able to secure such support by virtue of services rendered, and the funds thus provided should be given as a right, and not doled out as charity. It is my belief that the services now being rendered by the Davenport Academy are of such real value to the community that the burden of its support should no longer fall entirely, or even mainly, on the generosity of private individuals. This institution has long ago passed the experimental stage, and has proved beyond possibility of cavil its potency for good service to the community. It is in a position to ask and receive regular financial support from the City of Davenport as a small return for a great service which has been continuously rendered for many years.

In conclusion the writer would plead the excuse of a somewhat long service in museum work as an apology for offering two suggestions regarding things that should not be done, although they very generally are done in the smaller museums everywhere.

The first of these things to be avoided is the purchase of specimens brought in by local collectors. If the museum is in a position to pay for everything, then nothing can be said against this practice. But it is safe to say that there are no provincial museums that are sufficiently endowed to be beyond the need of strict economy. The fact is that if it once becomes understood among the local sporadic collectors, particularly boys, that the museum will pay for specimens, it will almost invariably be compelled to pay for material which would otherwise naturally be freely donated. This course works a double injury. It prevents the museum from realizing a sure and constant revenue in the way of donated local specimens, and it also results in a most unfortunate attitude on the part of the local youth. The boys should be induced to collect and bring in specimens for the good of the museum and the public, instead of placing the transaction on the low level of a commercial enterprise. The public or individual will take a keener personal interest in an institution that it is actively aiding than in one that it simply regards as a possible source of revenue. Every boy, girl, or man who brings a specimen and donates it outright will then feel a direct personal interest in the collections. He will bring his friends to see the bird or other specimen that he has given, and thus there will be estab-

lished a community of interest and effort that no amount of mere buying and selling could ever effect.

Another thing to avoid is the acceptance of special collections with the understanding that they are to be kept separate from the other collections in the museum. Few things have caused more real distress to the conscientious curator than this form of incubus that is forever being pressed upon his unwilling shoulders. On the other hand, there are few more insidious temptations than that held out to the trustees of a museum by the man who offers a really valuable collection as a gift, provided that it be given a separate room or case and bear the name of the donor. But the wise and experienced museum man will at once gently but firmly refuse any such donation, and in most cases a little frank explanation will convince the would-be donor that, if his object is to serve the public or the cause of science, he should make his gift absolutely free of any such conditions.

Nothing is more certain than that the acceptance of such a gift will sooner or later be regretted if the museum involved ever attains the dignity of a well arranged and well balanced exhibition of material. The curator will inevitably find that his well-planned schemes for a consistent display are forever being confronted by this ghost that will not down, and the result will be that he wishes that that particular collection, however valuable it once seemed, could be cast into the bottom of the sea, or anywhere else, so that it is forever out of his way. While it occasionally happens that a special collection is so nearly complete that it can logically be kept separate, such cases are so exceptional that they do not conflict with the general rule that should be rigidly adhered to in every museum that expects a healthy and long continued growth with elbow room for a correct system of installation.

STATE UNIVERSITY OF IOWA,
Sept. 18, 1905.

RECORDS

OF THE

DAVENPORT ACADEMY OF SCIENCES

1904-1906

1904

OFFICERS

Elected at Annual Meeting January 29, 1904

President,	A. W. ELMER
Vice-President,	C. H. PRESTON
Curator,	J. H. PAARMANN
Recording Secretary,	A. A. MILLER
Corresponding Secretary,	MISS S. G. F. SHELDON
Treasurer,	MISS ELIZABETH D. PUTNAM
Librarian,	C. E. HARRISON

TRUSTEES

W. L. ALLEN	DR. JENNIE McCOWEN
A. F. CUTTER	E. C. ROBERTS
C. A. FICKE	J. H. PAARMANN
E. S. HAMMATT	C. H. PRESTON
C. E. HARRISON	W. C. PUTNAM
J. F. LARDNER	MISS S. G. F. SHELDON

COMMITTEES

Publication—Miss Elizabeth D. Putnam, C. H. Preston, Samuel Calvin, E. S. Hammatt, J. H. Paarmann.

Library—C. E. Harrison, J. H. Paarmann, Miss S. G. F. Sheldon.

Finance—W. C. Putnam, C. A. Ficke, E. C. Roberts.

Lectures and Entertainments—Miss Elizabeth D. Putnam, A. F. Ewers, A. A. Miller, C. E. Harrison, E. S. Hammatt.

Museum—Zoölogy, J. H. Paarmann; Conchology, Miss S. G. F. Sheldon; Botany, A. F. Ewers; Ethnology, Miss E. D. Putnam; Archæology, C. E. Harrison; Geology and Paleontology, Dr. A. W. Elmer.

REPORTS OF MEETINGS

January 29, 1904—Regular Meeting.

Voted that the Museum should be opened free one Sunday afternoon in each month.

The following memorial resolution was adopted:

In Memoriam.—Again must the name of a long-time member and trustee of this Association be transferred from the roll of its active workers to that of its honored dead. The genial, kindly presence of J. H. Harrison will henceforth be missed from our assemblings. Exemplary in every relation of life, pure of heart, esteeming honor incalculably above profit, he was one of those truly successful men who through altruistic service win their richest and most prized treasures.

Resolved, That this tribute of our love and respect be spread on the minutes of the Academy and a copy transmitted to the bereaved family with the assurance of our sympathy in their deep grief.

C. H. PRESTON,
C. A. FICKE,
A. A. MILLER,
Committee.

February 26, 1904—Regular Meeting.

J. H. Paarmann reported on the meeting of the Iowa Anthropological Association in Iowa City.

Standing Committees for the year were announced.

March 3, 1904—Trustees' Meeting.

Voted to send an exhibit to the Louisiana Purchase Exposition in St. Louis.

March 25, 1894—Regular Meeting.

Routine business and discussion.

April 5, 1904—Trustees' Meeting.

Routine business.

May 3, 1904—Trustees' Meeting.

Routine business.

May 18, 1904—Trustees' Meeting.

Voted to accept a proposition from the School Board, that the curator should devote half time to the public schools, the first and last ten weeks of the school year at the Academy and the intervening twenty weeks at the schools.

Voted that the curator's salary for the half time devoted to Academy work be fixed at \$600 a year.

May 27, 1904—Regular Meeting.

G. R. Putnam, of the United States Coast and Geodetic Survey, gave a talk on the Philippine Islands.

September 30, 1904—Regular Meeting.

Routine business and discussion.

October 28, 1904—Regular Meeting.

Professor Frederick Starr was appointed delegate to the St. Louis Convention of the International Geographical Congress.

J. H. Paarmann reported on the Anthropological exhibit at the St. Louis Exposition; also that the Academy's exhibit of mound relics had been awarded a silver medal.

November 9, 1904—Trustees' Meeting.

Routine business.

December 30, 1904—Regular Meeting.

Routine business and discussion.

January 27, 1905—Annual Meeting.

Dr. A. W. Elmer, President, in the chair.

Reports of the officers and committees were read.

Officers for the year 1905 were elected.

REPORT OF THE CORRESPONDING SECRETARY FOR 1904.

The report of the Corresponding Secretary, Miss S. G. F. Sheldon, showed that arrangements had been made for the better handling of the Academy exchange list.

REPORT OF THE RECORDING SECRETARY FOR 1904.

The report of the Recording Secretary, A. A. Miller, noted the meetings, elections to membership, etc., during the year.

REPORT OF THE TREASURER FOR 1904.

GENERAL FUND—RECEIPTS.

Balance on hand January, 1904.....	\$	31.25	
Dues and subscriptions of members.....		686.50	
Subscriptions for improvements.....		500.00	
Interest from endowment fund.....		193.81	
Receipts, two lecture courses.....		632.76	
Income, Science Hall.....		160.00	
Door receipts.....		37.80	
Special gifts.....		1,126.30	\$3,278.42

EXPENSES.

Salary of curator.....	\$	866.64	
Janitor.....		279.90	
Current expenses.....		445.75	
Expenses, two lecture courses.....		494.50	
Transportation and expenses, Palmer collection.....		240.00	
Bills for 1903.....		404.47	
Paid on note and interest on account building improvements.....		621.27	
Balance on hand January, 1905.....		10.39	\$3,278.42

PUBLICATION ACCOUNT—RECEIPTS.

Balance on hand January, 1904.....	\$	271.14	
From Putnam Memorial Fund.....		570.00	
Interest from bank account.....		4.24	\$845.38

EXPENSES.

Printing Proceedings.....	\$	435.00	
Illustrations for Proceedings.....		187.30	
Preparation of index to Proceedings.....		30.00	
Wrappers, etc., Vol. IX.....		11.97	
Balance on hand.....		181.11	\$845.38

ELIZABETH D. PUTNAM, Treasurer.

ENDOWMENT FUND.

General Endowment.....	\$2,200.00
Publication Endowment Fund (approximately).....	125.00

In addition to these are the Putnam Memorial Fund, established by the will of Mary L. D. Putnam for publishing the Proceedings, and a bequest of J. Monroe Parker, not yet paid to the Academy.

ELIZABETH D. PUTNAM, Treasurer.

REPORT OF THE LIBRARIAN FOR 1904.

The report of the Librarian, C. E. Harrison, for 1904, showed 1,112 accessions, of which 8 volumes were acquired by purchase, 368 by gift, and the balance by exchange. A list of missing numbers of serials has been prepared, as well as a check list on cards for keeping account of exchanges, both by Miss Sheldon.

REPORT OF THE PUBLICATION COMMITTEE FOR 1904.

The Publication Committee reported the completion of Volume IX of the Proceedings, at a cost of \$1,056.65.

REPORT OF THE CURATOR FOR 1904.

In addition to giving an outline of the improvements needed in the museum, the curator reported as follows:

Work Accomplished During the Year:

Installation of the Palmer Collection of heads and horns.

Re-arrangement of the natural history collections.

Preparation and installation of an exhibit for the World's Fair at St. Louis.

Editing the material for Volume IX of our Proceedings.

Lectures to the school children.

Continuing the cataloguing of the library, writing for missing numbers of incomplete sets of serial publications, and making other improvements in the library.

Fitting up a room for the storing of our publications.

Summary of Donations:

Minerals	Several Collections
Fossils	6 specimens
Birds	8 "
Birds' eggs	40 sets
Mounted animal heads	42 specimens
Mounted animal horns	155 "
Other zoological specimens, about	400 "
Ethnographical specimens	106 "
Stone implements	200 "

Visitors to Museum (see appendix):

January.....	250	May.....	722	September	1,008
February.....	450	June	660	October.....	910
March	1,119	July.....	138	November....	486
April.....	1,262	August.....	148	December....	137
		Total for the year, 7,290			

ANNUAL ADDRESS OF THE PRESIDENT.

Ladies and Gentlemen—At the time of the discovery of America the whole of North America was inhabited by a wild nomadic race to whom was given the name of "Indians." This people was found to be divided into many tribes and federations, but were all of the same character and habits, slightly diversified, as they were influenced by climate and environment. Their houses and shelters were of the most primitive description, and they clothed themselves, where they found clothing convenient, in the skins of animals.

For food they depended mostly on the fruits of the chase and the natural products of the soil, with very little attempt at cultivation.

Each tribe dwelt within certain boundaries when not at war, but still moved about within these limits in search of game or as fancy might lead them. Their modes of sepulture were as crude as their modes of life, consisting in shallow graves or placing the remains on elevated platforms out of the reach of wild beasts, where time and decay brought both to mother earth in the end.

As the white races gradually occupied the land, it was soon observed that there were certain evidences of a more advanced development, and permanent habitation in the relics and works of a former race or generation.

These relics consisted mostly in earth-works such as are found the world over. In England they are called "Barrows" and associated with the Stonehenge, and in North Germany they are called "Hünengräber." They are mounds of various sizes, and were left by the ancient people of all countries. The prehistoric races of America left works over most of the Western Continent, in many instances in North America surpassing in size the Barrows of England and the North German graves, but differing in form and design from any found in other parts of the world. In Wisconsin, for instance, we find them taking the forms of men, beasts and birds, rudely sketched in embankments of earth many thousands of feet in extent. In Ohio are two monuments called "The Serpent" and "The Alligator," the names of which sufficiently describe them, and which attracted even the attention of the indifferent observers among the early settlers.

Many cities have received their names from the earth-works of prehistoric times in their vicinity, such as Moundville, W. Va., near which is one of the largest mounds on record, and Circleville, Ohio, where one of the curious forms of earth-works known as the "square and circle" suggested the name of the town.

In the Lake Superior copper region we find the remains of ancient mines worked by this people, and according to Newberry the lead mines of Kentucky and the oil wells of Canada and northwestern Pennsylvania were known to them and were to some extent developed.

Many of the mounds have been explored and most of them yielded nothing of interest, but in many instances there have been rich finds, including weapons of the chase and war, together with implements of domestic use, consisting of pottery, woven cloth, and charred remains of grain. The weapons are mostly of stone; but a few are of copper all flecked with silver, showing that they came from the Lake Superior region, as there copper is native and has this characteristic.

There has been much diversity of opinion as to the antiquity of these monuments and the possible origin of the people which left them; but it seems that the best accepted authorities consider them very old, and the race that they commemorate, one distinct from any found in these regions at the time of America's discovery. Certain it is that the oldest traditions of the Indian could not account for them, and no tribes found in the localities ever built such mounds or earth-works or even imitated them. The conclusion, therefore, is but reasonable that a very different race, or at least a generation of a very much greater degree of civilization, once inhabited the greater part of North America, and especially the Mississippi Valley.

MOUNDS OF SOUTHERN TEXAS.

With this introduction, the writer wishes to call the attention of the society to a certain peculiar variety of mounds found in the southern part of Texas and which, as far as he knows, have never been reported or described. The region in which they are found is a continuance of the Staked Plains, extending from the Mexican border and the Rio Grande along a plateau some 3,000 or 4,000 feet in elevation, to the north, where it broadens out into

the Ilanos Estacados, or Staked Plains. This plateau is cut into deep cañons, some of them containing the beds of rivers, but most of them dry and running water only during the wet season and only for a few hours at a time.

These cañons are from 100 to 1,000 feet in depth, that of the Pecos being one of the deepest, while the Howard, extending nearly parallel for a hundred miles or so, deepens until it joins the Pecos fifteen miles from the river Rio Grande, and is fully 1,000 feet deep at the point of juncture. These great ravines are joined by side cañons which are again joined by others of the same kind until the country is an intricate network of depressions, deep and steep-sided, and of such intricacy that it makes it very discouraging for one to attempt extended excursions unless well acquainted with the country.

There is no rainfall during the greater part of the year; but during the early months of summer there are downpours which, draining from the slopes as from the roof of a house, produce torrents which sweep everything before them; but the watercourses are again dry in a few hours, and water must be obtained from wells as soon as a few days' evaporation has dried up the natural pools. The ranchmen are obliged to drill wells from 200 to 600 feet in order to get water, and in places it has not been found even at 1,000 feet, and windmills are required to bring it to the surface. There is no chance for existence for man or beast a greater part of the year where these wells are not located.

There is very little soil and the vegetation is consequently scanty and of such character that only the native cattle can exist upon it eight months out of the twelve. Much of the surface is bare limestone where even the cactus cannot grow.

One would scarcely expect to find the remains of former inhabitants in such an inhospitable country, yet over this region are scattered the peculiar mounds before mentioned. They are not built of earth, as are the mounds of other localities, but are almost entirely constructed of stone, not mere stone heaps carelessly piled together nor laid so as to form any structure, but piled into regular, symmetrical mounds, and composed of stone broken into fragments all of about the same size. One is at once reminded of the macadam which is used on our roads and streets, and the mounds contain all the way from a dozen to fifty or more wagon-loads of this material. Mingled with the stone is a blackish earth, seemingly darker and richer than the surrounding soil, and forming a compact mass, over which grows the sparse vegetation found here.

These works are found mostly in the mesa, or upland, but to some extent they also occur in the shallower side cañons. In some instances they appear to be situated quite a distance from the source of the material of which they are made, and in others they lie among the limestone fragments and are only distinguished by the regularity of the stones which compose them.

They are mostly isolated, but are also found in groups, and occur at frequent intervals along the junction of the cañons and, as before mentioned, in the higher side depressions.

There is a very interesting group of these mounds about a cave on the range of Fred Wilkins of Val Verde county. The mounds were the largest seen in this whole region, being some five or six feet high and having a circumference of thirty or forty feet. They lie overlapping one another, as though the builders were short of space, and completely surround the entrance to the cave. At present the cavern shows but little room for habitation, but from appearances it was formerly much more extensive than now. The roof has fallen in at the inner end so that it has the appearance of having been filled up with earth and limestone débris. Why the mounds should have been built here so extensively is not very clear unless at some former time water was to be found within the depths of the cave, but at present it would offer neither shelter nor water.

An exploration of these mounds and the cave would doubtless give inter-

esting results, but would require considerable time and expense, being so far removed from the railroad and so difficult of access.

The few mounds which have been explored have yielded nothing of interest, but the investigation has been only cursory and superficial and therefore no indication that nothing is to be found in them. Most of the mounds in Arkansas and in other parts of the country contain no remains, just as might be expected from their great age. Under especially good conditions some parts of skeletons are found in the mounds opened throughout the states, but in many instances they are evidently of later date than the original builders, as it is well known that the Indians used the mounds as they found them as resting places for their dead, and excavators have taken these remains to be those of the original occupants.

That nothing has been thus far found in these stone mounds is, then, no argument that they are not the remains of an early race, but rather evidence of their antiquity, and more extended exploration will surely bring to light something of interest belonging to them. The mystery about these works lies in their distance from water and in the inhospitable conditions of the country. During most of the year the nearest water to some of the locations is not nearer than twenty miles, and yet the size of the mounds show that there must have been prolonged stays in their vicinity, where water is not known, and any food plants scarce during most of the year.

The Mexicans claim that the mounds were made by the Indians for the purpose of roasting sotol, a plant growing all about this region, having a thick, bulbous base, rich in starch, and which is sometimes used as food by the natives. This claim is manifestly absurd, as no such labor would need to be expended in making a mound of stone for this purpose, and the utility of such work for such an end is not in the least manifest. Were these monuments found only on the watercourses, or near the few springs, we might account more easily for their presence; and we can only conclude that the climate conditions must have been different when this mysterious people lived and died among the cañons of the Pecos in southern Texas.

WORK OF THE ACADEMY.

With 1904 ended a very satisfactory year for the Davenport Academy of Sciences. In all its departments there has been more than usual activity, and its financial prospects are steadily improving under the management of our able treasurer.

Many valuable specimens have been added to the museum, chief among which is the remarkable collection of heads and horns donated by D. D. and B. J. Palmer. This collection enables the observer to make a scientific comparison between the heads and horns of various animals, both as weapons of offense and defense, and ornamental head-dress. Among the antlers of the cervidæ are found the many curious anomalies peculiar to these annual growths, and the interlocked heads of the battling bucks give an idea of one of the tragedies of plain and forest.

The collection of mounted birds in the museum is growing very rapidly and is now probably, to the general visitor, the most interesting part of the exhibit. There have been many donations to this department during the year, and we have been notified by C. A. Ficke that he has shipped the Academy a collection of mounted birds from the far-away and interesting land of Japan. Other donations too numerous to mention have been received, among which are the archaeological and zoological specimens given by Mrs. Anna Wuestenberg, collected and owned by her late lamented son, Otto H. Wuestenberg.

The library has been increased by many additions, some by purchase but mostly by generous donations, and under the management of our corresponding secretary have been so well catalogued and listed that they are accessi-

ble to the reader and can be readily reached for sale or exchange where there are duplicates.

There have been the usual number of meetings during the year, with good attendance, and besides the regular lecture course we have been favored with two addresses, one on the Philippines by George R. Putnam, and one on the anthropological exhibit at the World's Fair in St. Louis by J. H. Paarmann. The regular lecture course has been particularly successful both as to attendance and general interest as well as remunerative to the society, while the course of instruction to the school children has become a part of the public school training and gives our Academy an undisputed place among the institutions of education. This has been a long wished for consummation and was first originated and worked for by our late president, Mrs. Putnam, and undoubtedly is the most important part of our labors. That we have attained this point is most gratifying, and there is no doubt but that our field of usefulness will open wider and wider as time goes on.

During the summer past we have given the world a chance not only to learn of us but to learn *from* us in the exhibit placed in the ethnological department of the Louisiana Purchase Exposition at St. Louis. A silver medal was awarded us for this, which has become one of our valuable possessions, and will represent to future generations the work of the society in the early years of the twentieth century.

We have lost two members during the past year, J. J. Humphrey and Capt. W. P. Hall. In each we have lost a good friend, but in the latter we have lost much more. Capt. Hall was not only a friend to our institution, but was an integral part of it, and the Academy became a part of him, in his thoughts and deeds. During the most vigorous years of his life he devoted his whole time to the exploration and excavating of the mounds of the Mississippi Valley for the benefit of our museum, as every shelf will testify, and in his later and failing years he never lost an opportunity of acquiring, by gift or purchase, any specimen which came within his notice for the same purpose. As long as the Davenport Academy of Sciences stands it will owe a debt of gratitude to Capt. W. P. Hall for the generous and single-hearted zeal with which he labored for its advancement.

1905.

OFFICERS

Elected at Annual Meeting January 27, 1905.

President,	A. W. ELMER
First Vice-President,	C. A. FICKE
Second Vice-President,	C. H. PRESTON
Curator,	J. H. PAARMANN
Recording Secretary,	A. A. MILLER
Corresponding Secretary,	MISS S. G. F. SHELDON
Treasurer,	MISS ELIZABETH D. PUTNAM
Librarian,	C. E. HARRISON

TRUSTEES

W. L. ALLEN	DR. JENNIE McCOWEN
A. F. CUTTER	J. H. PAARMANN
A. F. EWERS	C. H. PRESTON
C. A. FICKE	W. C. PUTNAM
E. S. HAMMATT	E. C. ROBERTS
C. E. HARRISON	MISS S. G. F. SHELDON

COMMITTEES

Publication—Miss Elizabeth D. Putnam, C. H. Preston, Samuel Calvin, E. S. Hammatt, J. H. Paarmann.

Library—C. E. Harrison, J. H. Paarmann, Miss S. G. F. Sheldon.

Finance—W. C. Putnam, C. A. Ficke, E. C. Roberts.

Lectures and Entertainments—Miss Elizabeth D. Putnam, A. F. Ewers, A. A. Miller, C. E. Harrison, E. S. Hammatt.

Museum—Zoölogy, J. H. Paarmann; Conchology, Miss S. G. F. Sheldon; Botany, A. F. Ewers; Ethnology, Miss E. D. Putnam; Archæology, C. E. Harrison; Geology and Paleontology, A. W. Elmer.

February 24, 1905—Regular Meeting.

A. W. Elmer and J. H. Paarmann were appointed delegates to the meeting of the Iowa Society of the Archæological Institute of America to be held in Iowa City.

J. H. Paarmann reported on the meeting of the Iowa Anthropological Society held in Iowa City, February 17-18, 1905.

March 31, 1905—Regular Meeting.

The following papers were presented for publication and referred to the Publication Committee:

"The Aftonian Gravels and their Relations to the Drift Sheets in the Region about Afton Junction," by Prof. Samuel Calvin, of the University of Iowa. [Published in the Proceedings, Vol. X.]

"A Comparative Study of the Vegetation of Swamp, Clay, and Sandstone Areas in Western Wisconsin, South-eastern Minnesota, and North-eastern, Central and South-eastern Iowa," by Prof. L. H. Pammel, of the Iowa State College, Ames, Iowa. [Published in the Proceedings, Vol. X.]

May 26, 1905—Regular Meeting.

A paper on the "Fishes of Hong Kong," by Dr. David Starr Jordan, of Leland Stanford Jr. University, was presented for publication and was referred to the Publication Committee. [Published in the Proceedings, Vol. X.]

Edward K. Putnam, of Leland Stanford Jr. University, California, read a paper on "The Value of Natural History to the Student of English."

June 30, 1905—Regular Meeting.

J. H. Paarmann exhibited a case of seventeen-year locusts collected by Miss Sheldon in Fejervary Park, showing different stages of development.

September 29, 1905—Regular Meeting.

A. W. Elmer reported that he had opened two mounds during the summer, but had found nothing of importance.

A. A. Adams, Director of Manual Training Department, Davenport Public Schools, lectured on "Travels in Mexico," illustrated by lantern slides. The lecture described the people, their manners, customs, and dress.

October 27, 1905—Regular Meeting.

The following papers were presented for publication and referred to the Publication Committee:

"Some Coccidæ from the Philippine Islands," by Prof. T. D. A. Cockerell, of the University of Colorado. [Published in the Proceedings, Vol. X.]

"Provincial Museums," by Prof. C. C. Nutting, of the University of Iowa. [Published in the Proceedings, Vol. X.]

Miss Bush gave an account of her work of preparing Indian stories for primary children. She had found much material in the Academy library.

The report of the mound exploration party showed that five mounds were opened near Dixon, Iowa, with no finds except some badly decomposed bones in the mound in Clinton county.

November 24, 1905.

C. A. Ficke gave a lecture on "Japan" at the Grand Opera House. No business meeting.

December 29, 1905—Regular Meeting.

The following papers were presented for publication and referred to the Publication Committee:

"The Drone Fly," by Baron C. R. Osten Sacken, of Heidelberg, Germany. [Published in the Proceedings, Vol. X.]

"On Certain Fossil Plant Remains in the Iowa Herbarium," by Thomas H. Macbride, of the University of Iowa. [Published in the Proceedings, Vol. X.]

"Descriptions of New Forms of Jassidæ," by Herbert Osborn, of the Ohio State University. [Published in the Proceedings, Vol. X.]

Voted to offer the Davenport Public Library any duplicates the Academy had that the Library could use.

January 10, 1906—Trustees' Meeting.

W. C. Putnam and Elizabeth D. Putnam, trustees of the Putnam Memorial Fund, under the will of the late Mrs. Mary L. D. Putnam, presented the following report:

REPORT OF THE PUTNAM MEMORIAL FUND.

The undersigned, Elizabeth D. Putnam and W. C. Putnam, have the honor to report that W. C. Putnam, the legal trustee of the Putnam Memorial Fund under the will of Mary L. D. Putnam, deceased, has received the sum of twenty-four thousand (\$24,000) dollars (approximately) from the estate of Mary L. D. Putnam, deceased, and now holds this sum invested for the benefit of the Davenport Academy of Sciences under the provisions of said will. It is provided in this will that the distribution of the income of the Putnam Memorial Fund shall be under the control of a board of three (3) trustees, two of these being the undersigned named in the will and the third to be chosen by the trustees of the Academy. And these trustees would now ask that they place the name of Hon. C. A. Ficke to fill the vacant place on this board.

ELIZABETH DUNCAN PUTNAM.
WILLIAM CLEMENT PUTNAM.

The report was accepted and Mr. Ficke was elected.

The Finance Committee presented the following report:

REPORT OF THE FINANCE COMMITTEE FOR 1905.

The undersigned, chairman of the finance committee, has the honor of presenting to the Davenport Academy of Sciences and to its board of trustees their report of its operations for the past year. It shows that by strenuous efforts the Academy was at last enabled to pay off all its debts and close its books without owing a dollar in the world, directly or indirectly. This is probably the first time since the founding of the Academy nearly forty years ago, that this could be said in connection with this report. The com-

mittee desires to state that the grounds and buildings of the Academy, which consists of a frontage of 190 feet on Brady street by 140 feet on Seventh street and improvements thereon, are all in splendid repair and condition. And furthermore, that the general endowment fund of the Academy consists as follows:

General endowment	\$ 2,200.00
Putnam Memorial Fund	23,928.49

and in addition a bequest of \$1,000.00 from the estate of the late J. Monroe Parker not yet paid over to the Academy. So we feel that the Academy is to be congratulated on its splendid financial condition, but people must remember that this is only a means for accomplishing still greater ends in the future, in developing the internal work of the Academy in providing new cases and apparatus and assisting in the important work of the Academy in the schools.

Respectfully submitted,

W. C. PUTNAM,

Chairman Finance Committee.

January 10, 1906—Annual Meeting.

A. W. Elmer, President, in the chair.

The annual reports of the officers were received and filed and the President's address read.

Officers and trustees were elected.

The President-elect, C. A. Ficke, upon taking the chair, spoke of the creditable position held by the Academy in the community and urged that all join in an effort to add one hundred new members.

REPORT OF THE CORRESPONDING SECRETARY FOR 1905.

The report of the Corresponding Secretary, Miss S. G. F. Sheldon, showed that many missing numbers of serials had been secured and that Vol. IX of the Proceedings had been distributed and a number of institutions added to the exchange list.

REPORT OF THE RECORDING SECRETARY FOR 1905.

The report of the Recording Secretary, A. A. Miller, recorded the meetings, elections to membership, etc., during the year.

REPORT OF THE LIBRARIAN FOR 1905.

The report of the Librarian, C. E. Harrison, showed 1,637 accessions for the year. Donations had been received from Miss J. E. Sanders, the Misses Decker, Miss E. D. Putnam, Miss S. G. F. Sheldon, and C. G. Plummer. A number of handbooks, useful for the educational work of the Academy, had been purchased.

REPORT OF THE TREASURER FOR 1905.

RECEIPTS.

Cash on hand January 31, 1905.....	\$	10.39
Initiation fees, subscriptions and dues		849.50
Gifts, donations and bequests		438.00
Subscriptions to building fund.		75.00
Interest		186.61
Income from Science Hall (net)		141.30
Museum door receipts		3.20
Museum contributions		5.20
Sale of duplicate books, etc	30.65	\$1,772.85

EXPENSES.

Salary of Curator	\$	600.00
Salary of Janitor		250.00
Water.....		21.12

Plumbing	81.15	
Books	38.17	
Gas and electric light.....	27.45	
Pictures	9.50	
Fuel	74.54	
Repairs	55.21	
Sundries	9.60	
Bills payable (note and interest).....	409.64	
Binding	21.05	
Birds and taxidermy	36.95	
Photographs	6.00	
Archæological Institute, two memberships	20.00	
Freight and express.....	7.53	
Supplies	15.65	
Balance on hand January, 1906.....	88.69	\$1,772.85

PUBLICATION ACCOUNT—RECEIPTS.

Balance on hand January 31, 1905.....	\$ 181.11	
Income Putnam Memorial Fund.....	1,770.00	
Interest from bank.....	3.99	\$1,955.10

EXPENSES.

Printing, electrotyping and binding	\$ 957.85	
Distribution of Proceedings.....	57.30	
Drawings	199.88	
Balance on hand January, 1905.....	740.07	\$1,955.10

ENDOWMENT FUND.

General Endowment.....	\$ 2,200.00
Publication Endowment Fund, approximate.....	125.00

In addition to this are the Putnam Memorial Fund, established by the will of Mary L. D. Putnam for publishing the Proceedings, and a bequest of J. Monroe Parker, not yet paid to the Academy.
ELIZABETH D. PUTNAM, Treasurer.

REPORT OF THE CURATOR FOR 1905.

The curator, J. H. Paarmann, discussed the needs of the museum, and reported in part as follows:

IMPROVEMENTS IN THE MUSEUM.

During the past year a large number of new specimens have been installed. A beginning has been made in collecting an exhibit illustrating the native trees of our state. For this purpose it is desirable to display wood, bark, leaves, fruit, and pictures showing the characteristic mode of growth of each species. Portions of the trunks of sixteen species of trees, collected by Prof. L. H. Pammel of the Iowa State Agricultural College, are now on exhibit in the museum.

The Eskimo exhibit, consisting of articles illustrating the dress, hunting implements, household utensils, and boats of the Alaska and Greenland Eskimo, has been increased by a large loan collection of Eskimo clothing deposited in the museum by G. M. Cole.

The Academy may justly be proud of its shell collections, which are probably more complete than those of any other group in the museum.

RELATION OF THE ACADEMY TO THE SCHOOLS.

There are several ways in which the Academy may be of use to the schools. As teachers of the elementary schools become more familiar with the Academy library they realize that from its shelves they may draw much that will be helpful in the teaching of geography, history, and nature study; while to the science teachers of the High Schools and Colleges of the tri-cities the library is an invaluable help. The museum offers to almost all classes of teachers material with which to illustrate their lessons. How much more vivid, for instance, a picture of Eskimo life becomes to the little children when the words of the teacher, pictures, and text-book are supplemented with the real objects made and used by these people. I believe there is not a more useful field for the Academy than helping teachers to obtain

material with which to illustrate their lessons in geography, history, nature study, and other subjects.

Besides offering to the schools its library and museum the Academy seeks to aid in developing interest in the study of nature by offering courses of instruction to the school children. For several years lessons were given to classes at the museum whenever teachers made application to the curator for the same.

In 1904 the School Board of the City of Davenport voted to employ the curator of the Academy for one-half time to teach science in the public schools of the city. Since September, 1904, therefore, the forenoon of each school day has been spent in giving instruction and the remaining time has been devoted to the Academy. The work was at first in an experimental stage. Two questions came up: How many and which grades should receive this instruction? Should the lessons be given at the museum or at the schools? It seems to me that with the amount of time now at our disposal the best results may be obtained by confining the work to the upper grades, say from the fifth to the ninth, inclusive. Much of city life is artificial and opposed to the symmetrical and healthy development of mind and body. From the kindergarten to the post-graduate course in the university excellent opportunities are afforded for the study of nature. In the kindergarten are the nature games; in the first four or five grades the language lessons about trees, flowers, and animals; in the high school and university, required work in some natural science; but in the latter half of the elementary school course, especially the upper grades, nature study at present receives very little attention. In answer to the second question I should say that most subjects can be better taught at the schools than at the museum. There are, of course, exceptions to this rule, as where the nature of the specimens to be studied, on account of size or number, prevents their being taken from school to school. In such cases classes would have to come to the museum. When lessons are of such a nature that specimens lend themselves to being carried, then I should give the lesson at the school for the reason that much time is saved, as five school-rooms may be visited in half a day, while but one class can profitably receive instruction at the museum during the same time.

VISITORS TO THE MUSEUM.

(See Appendix).

ADDITIONS TO MUSEUM.

	NO. SPECIMENS.		NO SPECIMENS.
Ethnography	17	Corals	44
American Archæology.....	8	Insects	1
Egyptian Archæology.....	1	Other Zoölogical specimens....	7
History.....	5	Botany	66
Mammals.....	6	Minerals.....	3
Birds.....	66		

Several hundred specimens of Periodical Cicada (seventeen-year locusts) showing different stages from the eggs to the adult form were collected.

ANNUAL ADDRESS OF THE PRESIDENT.

Ladies and Gentlemen—As each year brings its failures and successes, they are fortunate who are able to find a balance on the side of success, be it ever so small; but most fortunate are they who at the end of the year find their failures few and their successes many.

The Davenport Academy of Sciences leaves another milestone behind on a road of prosperity, and can look from accomplished work and achieved success to new aims and higher ambitions for the coming year.

We find there has been a marked increase in the number of visitors to the museum and library during the last twelve months, which can be taken as

the surest indication of the interest taken in our institution by the public, and the number of donations to both gives evidence of the hearty good will which is constantly shown us.

The monthly meetings have been held with more than usual regularity, and the attendance has been above the average, while many of our meetings have been made instructive as well as entertaining by means of papers and illustrated lectures.

There has been considerable increase in the membership, and the Academy has acquired some very valuable members, both at home and abroad, who will help to shape our future with their work and add their names to our roll of honor.

Our work in the schools has met with deserved recognition, an interest in the natural sciences has been shown by the pupils of the public schools, which is most gratifying; and the society has assumed and holds a place in educational work worthy of its resources, with promise of more extended fields of operation in the years to come.

The lecture course, as in the past years, has proven a success, and this feature of our labors bids fair to rival the work done in the schools, from an educational standpoint, reaching as it does the minds of maturer years, and presenting knowledge in a way that is both pleasure-giving and instructive.

For the first time in many years we are able to say that our society is free from debt, our obligations all canceled, and a fine property assured to us which will make possible any extension the growth of museum and library may make desirable.

That we have been able to acquire this property at so little sacrifice is due in the first place to our lamented president, Mrs. Putnam, and in the second to the generous effort of two of our members who have had the welfare of our Academy at heart and have spared no exertion or expense to make it possible to say today that we are out of debt. There are many who have contributed liberally, both among our members and our friends, and to them too is due much of the credit; and while we thank them one and all, we still owe the greatest part of our gratitude to Miss Putnam and to the Hon. C. A. Ficke.

Our publications are being put out as fast as the matter is ready for the printer, and this very important part of our work has been carried on under the able direction of our publication committee, crystalizing and condensing the results of our annual efforts into the neat volumes of our publications.

During the summer there were some attempts made to renew the archaeological investigation of our region, and on two occasions mounds were opened in Clinton county, one of which the writer begs to report. The location of the group of mounds visited at the time is on the bank of the Wapissinicon River in Clinton county, section 13, range 1 east, and township 81 north, in Spring Back township. These mounds are situated along a high ridge overlooking in part the old bed of the river and terminating in a high, abrupt bank, the foot of which was washed by the waters of the river in time out of memory before its course changed. The mounds were distributed in groups and singly along this ridge for nearly half a mile, and before the plow and harrow effaced them fifteen or twenty of these tumuli might have been counted over this extent. When the land was first taken up a house was built on the site of the most prominent group, and the changes which have taken place since then in remodeling and rebuilding dwellings, barns and other outhouses have now obliterated all trace of what was the most interesting part of these ancient works. Within the writer's memory some of these mounds were yet some six or eight feet high, with a diameter of fifteen or twenty feet. All these have now been leveled off with the surrounding surface, leaving no means by which to locate where they once stood or to direct where to excavate in order to find what may have been placed beneath their foundations.

Through the kindness of Mr. Henry Ficke of Wheatland it was made possible to open two of the mounds at the farther end of this group where they overlook the present course of the river on the farm of Fred Rowald. It was with extreme difficulty that the outlines of these mounds could be traced, as the fields in which they lie have been under constant cultivation for more than fifty years, and where twenty-five years since they were still several feet high and very clearly outlined, they are now so little above the common level that they blend in outline with the curves of the hill and their location is made well nigh impossible. In fact, had it not been for a previous knowledge of their location, gained in former years, they would undoubtedly have escaped notice.

A trench was opened through each mound from north to south and another was made at right angles to the first, what seemed the longest diameter being taken for the first trench. At the junction of the trenches in both mounds bones were found after the first few strokes of the spade, which unhoped for good luck made subsequent proceedings much lighter than might have been expected. A stone knife and an arrow point were the only finds in the second, but the location of three layers of bones in the first was more interesting. The first found were so near the present surface that the plow had disturbed and brought them to light. The next layer was about a foot below the first, but lying in a different direction, while a third skeleton was found, in part at least, four feet below the first and extending also in a different direction from the other two. No stone weapons or instruments were found here, but throughout the mound were found small bits of charcoal and fragments of stone, all of the same character, as if this peculiar variety may have had some purpose in the burial rites. Nothing was found of interest in the second mound save a single layer of bones at about the level of the second burial in the first, with the same fragments of stone and charcoal dispersed throughout, together with the knife and arrow point above mentioned.

The lowermost bones in the first mound must, at the time of its completion, have been something like eight feet below the surface, while the topmost interment was at about the general surface level. All through the fields in this region, and especially where the mounds are situated, arrow heads and other stone weapons or implements have been found for many years, and flint flakes may still be seen after every rain scattered in profusion over the surface. Many of the mounds have been opened in former years by the farmer boys and many relics taken from them, but there is no account of any metal of any description being found, and the absence of iron in any shape would tend to prove that the mounds were erected before the advent of the white man, probably centuries before, as in many places the bones can only be followed by an ash-like trace in the earth so complete is the disintegration. A few hundred years since in this locality there was a community teeming with life and activity which has disappeared, leaving only these earthworks to tell that they once lived and but a few years more and there will be no trace of them left, and even that their monuments once were here will be forgotten.

Death has again claimed for his own from our membership, and we mourn the loss of Dr. J. W. H. Baker and Mrs. J. B. Phelps. In the former we have lost one whose long and useful life made him a shining example of all that is good, kind and skillful as a physician, and generous, clear-headed and conscientious as a citizen; in the latter we have lost a good woman and a good friend of the Davenport Academy of Sciences.

In giving over the cares and responsibilities of the office with which the Society has honored the writer the past two years, it might be well to call attention to the fact that we are at present deficient in original work and investigation along certain lines which our location makes possible and even advantageous. Our adjacent quarries afford a fine field for paleontology,

the flora of our adjoining fields and the woods and meadows of the Rock Island Arsenal offer a wide range to the botanist, and the many earthworks of a vanished race still untouched in our vicinity leaves room for archæological investigation in which our Society once held the foremost position in the state, and possibly in the country at large. Formerly our members discovered and named fossils; described plants new to science, or gave to the world the secrets of unknown insect life, and today while we can no longer boast a Barris, a Parry or a Putnam in these sciences, we must still have those among us who, fired by their example, might, with the help of our museum and library, take any of these branches and win for themselves a name in the scientific world and gain further honors for the Davenport Academy of Sciences.

1906.

OFFICERS

Elected at Annual Meeting January 10, 1906.

President,	C. A. FICKE
First Vice-President,	C. E. HARRISON
Second Vice-President,	HENRY MATTHEY
Corresponding Secretary,	MISS S. G. F. SHELTON
Recording Secretary,	A. A. MILLER
Treasurer,	MISS ELIZABETH D. PUTNAM
Librarian,	A. F. EWERS
Curator,	J. H. PAARMANN

TRUSTEES—EX-OFFICIO

President, C. A. FICKE	Treasurer, MISS E. D. PUTNAM
Recording Secretary, A. A. MILLER	

TRUSTEES

W. L. ALLEN	DR. JENNIE MCCOWEN
A. F. CUTLER	J. H. PAARMANN
A. W. ELMER	C. H. PRESTON
A. F. EWERS	W. C. PUTNAM*
E. S. HAMMATT	E. C. ROBERTS
C. E. HARRISON	MISS S. G. F. SHELTON

COMMITTEES FOR 1906

Publication—Miss Elizabeth D. Putnam, C. H. Preston, Samuel Calvin, E. S. Hammatt, J. H. Paarmann.

Library—Edward K. Putnam, J. H. Paarmann, Miss S. G. F. Sheldon.

Finance—Nathaniel French, M. N. Richardson, J. H. Hass.

Lecture—Miss Elizabeth D. Putnam, A. F. Ewers, A. A. Miller, C. E. Harrison, Charles Grilk.

Museum—History, C. M. Waterman; Ethnology, Miss E. D. Putnam; Conchology, Miss S. G. F. Sheldon; Zoölogy, A. W. Elmer; Botany, A. F. Ewers; Geology, H. E. C. Ditzen; Archæology, C. E. Harrison.

Program—J. H. Paarmann, W. D. Wells, L. F. Guldner.

January 15, 1906—Special Meeting.

Voted to close the Academy on January 17th, the day of the funeral of the late W. C. Putnam.

*Died January 13, 1906.

Voted to adopt the following resolution:

In the death of William Clement Putnam, which took place at his home in this city, January 13th, 1906, the Davenport Academy of Sciences has suffered the loss of a most helpful associate and adviser. Deeply interested in its welfare and wisely active in its counsels from his boyhood, he accepted as a filial trust the burden laid down by his honored mother, and together with his sorrowing sister has since given to its interest the most watchful care. To his wise business management are very largely due the Academy's present prosperity and usefulness.

To business talents and legal ability of a high order Mr. Putnam joined rare scholarly tastes and the purest integrity. Public spirited, and having the best interests of the community deeply at heart, his many beneficent activities will be sadly missed.

Recognizing the Academy's great loss in his untimely death, be it

Resolved, That this expression of our high esteem be transmitted, together with the assurance of our deepest sympathy, to the bereaved family, and that it be spread on our minutes for publication in our Proceedings.

C. H. PRESTON,
A. W. ELMER, } Committee.
C. A. FICKE,

January 29, 1906—Trustees' Meeting.

Voted to authorize the President to act for the Trustees in legal matters connected with the probate of the will of the late W. C. Putnam, by which his estate will eventually go to the Academy.*

January 29, 1906—Regular Meeting.

The President, C. A. Ficke, referring to the death of W. C. Putnam, spoke in part as follows:

You will recall how, just five years ago, when the Academy, on its thirty-third anniversary, opened Science Hall, which it acquired chiefly through the efforts of Mrs. Mary L. D. Putnam, that noble woman made an earnest appeal for an endowment of \$50,000 for the Academy in order that its usefulness might be enlarged and its valuable museum and library might be properly cared for and enlarged. Search where you will and where can you find a more beautiful and inspiring example of filial love and devotion than that which we behold in the response that was made by her own son to this appeal. This son, William Clement Putnam, although professional and business interests were taxing his time and energies to the utmost, during her life not only gave cheerfully and unstintingly of these, but of treasure, too, in support of the institution his mother so dearly loved. Upon her death, in loyalty to her memory he redoubled his efforts in behalf of that institution and thenceforth until his own untimely death, like his sister, Miss Elizabeth D. Putnam, was indefatigable in building up the Academy and developing its usefulness upon the lines planned by their mother.

But note the climax. When he came to meditate upon the question, what would become of the institution to whose upbuilding his mother had given the best years of her life when he no longer in person should be able to guard its interests and watch over its welfare, he penned that memorable document in which he answered the appeal made by his mother at the opening of Science Hall. He gave the Academy not only the \$50,000 asked for, but gave to it property valued at many times that sum. I repeat, you will search in vain for a more inspiring example of filial love. And to add to the beauty of their mother's loyalty to an institution dedicated to the advancement of learning, and to their brother's loyalty to both mother and this institution, an equally devoted daughter, and equally devoted sons, applaud from the depth of their heart the noble response of their brother to the appeal of their mother.

But, with this noble gift to our institution, there comes not only to us, its members, but also to the people of our city and state, a solemn duty. That duty is to guard with never ceasing vigilance the interests of this institution;

*The portions of the will of W. C. Putnam relating to this bequest to the Davenport Academy of Sciences are published with his memoir at the beginning of this volume. The entire will is also published as a separate pamphlet.

to be ever mindful of the high purposes for which it was established; to develop it on the broad lines on which it was planned by its founders and on the yet broader lines on which it was being built up by its benefactors; to make it in the truest sense of the word an institution for the increase and diffusion of knowledge among men; to make it a center of science and art.

February 23, 1906—Regular Meeting.

The first clause of Article II of the By-Laws was amended as follows:

Regular members shall be elected in the manner hereinafter prescribed. Candidates for regular membership must be recommended, in writing by two members, and shall be proposed at a regular meeting, and balloted for at a subsequent regular meeting. The business of the Academy shall be managed by, and its officers elected from, the regular members.

Also voted to repeal the next to the last clause of Section 5 of Article II, reading as follows: "Every regular member shall be subject to an annual fee of three (\$3.00) dollars, commencing on the 1st of January first following his election, and payable to the Treasurer, in advance," and to substitute for the same the following:

Every regular member shall be subject to an annual fee of three (\$3.00) dollars, payable to the Treasurer, in advance, on January 1st of each year. New members elected after the first quarter of the year shall, upon their election, pay only the pro rata portion of the annual dues for that year. All members shall, upon payment of annual dues, receive a membership card signed by the Treasurer, which shall entitle them to free admission to the lectures given under the auspices of the Academy.

One hundred and sixteen persons were elected to regular membership.

The Standing Committees were announced.

An official seal for the Academy was adopted.

H. E. C. Ditzen read a paper on "Life and Habits of the Starfish."

March 30, 1896—Regular Meeting.

The Lecture Committee reported the successful conclusion of the course.

Twenty-nine persons were elected to regular membership.

A. F. Ewers read a paper on "The Vegetable Cell," illustrated by lantern slides.

April 27, 1906—Regular Meeting.

J. A. Udden, of Augustana College, Rock Island, gave a lecture on "Some Evidences of Glaciation."

The following papers were presented for publication and referred to the Publication Committee:

"The Birds of Iowa," by Rudolph Martin Anderson, of the State University of Iowa. [Published in the Proceedings, Vol. XI.]

"The Protozoa of Iowa," by Charles Howard Edmondson, of the State University of Iowa. [Published in the Proceedings, Vol. XI.]

May 25, 1905—Regular Meeting.

Routine business and discussion.

May 29, 1906—Trustees' Meeting.

Voted to expend a sum not to exceed \$200 for binding books.

Voted to employ a taxidermist, as needed, to care for the collection of mounted birds.

June 29, 1906—Regular Meeting.

Routine business and discussion.

July 27, 1906—Regular Meeting.

Voted to send the California Academy of Sciences a set of the Academy Proceedings to replace those lost in the San Francisco fire.

August 31, 1906—Regular Meeting.

Demonstration of the Opaque Projector, an instrument for projecting images upon a screen by means of reflected light.

September 28, 1906—Regular Meeting.

Edward K. Putnam gave an account of the California earthquake, illustrated by photographs.

October 26, 1906—Regular Meeting.

Curator Paarmann reported upon the opening of a mound [No. 65]* near Albany, Ill., by a party of Academy members. This mound yielded some important additions to the Academy's museum. The objects found were shown, and views showing the progress of the work were thrown upon a screen. Discussion.

November 5, 1906—Trustees' Meeting.

Edward K. Putnam, Trustee of the Putnam Memorial Fund for the benefit of the Academy, explained the present condition of the fund. This was followed by a general discussion of the present needs of the Academy, and also of the objects to be sought for in its future development.

A committee was appointed to recommend changes in the Constitution.

November 30, 1906—Trustees' Meeting.

The Executive Committee reported on the most pressing needs of the Academy.

The Committee on Constitution presented a revision of the Articles of Incorporation and Constitution and recommended its adoption.

Voted that the Executive Committee be instructed to carry out certain recommendations to lessen the danger of fire in the Academy buildings.

Voted to grant the application of Ludwig Guldner, J. H. Paarmann, C. F. Kemmerer, T. W. Kemmerer, H. E. C. Ditzen, C. Meyer, Jr., C. A. Kellogg, Jr., O. H. Lowary, and A. F. Ewers, to form a Section of the Academy to stimulate individual research.

November 30, 1906—Regular Meeting.

Prof. C. C. Nutting, of the University of Iowa, addressed the Academy on "The Function of the Provincial Museum." [Published in the Proceedings, Vol. X.]

December 28, 1906—Trustees' Meeting.

Voted to recommend to the Academy the adoption of the revised Articles of Incorporation and Constitution.

* Hereafter, Albany mounds will be designated by the numbers given them in the plat made by W. H. Kimball, 1907.

Voted to utilize Science Hall for museum purposes, the alterations to be made as soon as finances will permit. A. F. Ewers, E. K. Putnam, and A. F. Cutter were appointed a committee for this purpose with power to act.

December 28, 1906—Regular Meeting.

The Articles of Incorporation and Constitution were amended in accordance with the recommendations of the Board of Trustees. [Printed at end of this volume.]

A. W. Elmer read a paper on "Iron Found in the Albany Mounds."

The Curator reported on the finds in the second mound [No. 70] opened at Albany.

January 8, 1907—Annual Meeting.

The President, C. A. Fieke, in the chair.

Reports of the officers and committees were read.

Officers for the year 1907 were elected.

REPORT OF THE CORRESPONDING SECRETARY FOR 1906.

The report of Miss S. G. F. Sheldon, the Corresponding Secretary, gave details of the correspondence during the year, and also of matters connected with the exchange of publications.

REPORT OF THE TREASURER FOR 1906.

The report of Miss Elizabeth D. Putnam, the Treasurer, follows:

RECEIPTS.

Dues.....	\$ 628.00	
Subscriptions.....	544.25	
Putnam Memorial Fund	110.00	
Interest.....	100.50	
Expenses.....	100.00	
Science Hall.....	1.00	
Rebate, account of water.....	22.48	
Door receipts.....	20.15	
Sale of publications	88.69	\$2,166.19
Cash balance as per last report		

EXPENSES.

Salary of Curator.....	\$ 600.00	
Salary of Janitor.....	314.00	
Fuel.....	151.48	
Light.....	18.00	
Water.....	8.25	
Building repairs and expenses.....	16.91	
Office supplies and expense.....	47.07	
Printing.....	10.40	
Addition to library	1.00	
Library expense.....	0.00	
Museum expense.....	50.58	
Insurance.....	90.00	
Freight and expressage.....	12.74	
Mound-exploring expense.....	135.10	
Lecture expenses.....	350.70	
Electric light fixtures.....	197.95	
Balance on hand	22.70	\$2,166.19

PUBLICATION ACCOUNT—RECEIPTS.

From Putnam Memorial Fund.....	\$1,000.00	
From interest on bank deposit.....	12.50	
From refund, typographical changes.....	23.00	
Balance on hand January, 1906.....	740.07	\$1,775.63

EXPENSES.

Printing.....	\$1,370.65	
From interest on bank deposit.....	12.50	
From refund, typographical changes.....	23.00	
Balance on hand	348.48	\$1,775.63

REPORT OF THE PUBLICATION COMMITTEE FOR 1926.

The Publication Committee reported that owing to many unforeseen delays Volume X had not been completed, but would be in a few months. Two papers had been accepted and printed in Volume XI.

REPORT OF THE CURATOR FOR 1926.

The first part of the report of J. H. Paarmann, the Curator, treats of the purpose of museums, outline of the past year's work, suggestions for the work of the coming year, the need of a larger staff for carrying on the work of the museum, library, publications, etc., and the need of additional floor space, cases, and accessories, for the museum. The report continues:

An exhibit and a study series of the mussel shells from this locality has been prepared. It contains every species of mussel found in the vicinity of Davenport. A pearl and pearl shell exhibit has been arranged; also one to illustrate the pearl button industry of the Mississippi Valley, this latter collection being the gift of J. F. Boepple. These exhibits, together with the remainder of our shell collections, have been installed in a fine new case designed especially for the purpose. A catalog of the shell collection has been prepared on cards. About 6,000 library cards were used for this catalog. The entire work of preparing this exhibit was done by Miss Sheldon, to whom the Academy is also indebted for the case and the card catalog and other supplies used in preparing the specimens for exhibition or study. Miss Sheldon has also classified and stored, so as to be easily accessible for study or exchange, our large supply of duplicate specimens of land and river shells from this and other localities.

LECTURES TO SCHOOL CHILDREN.

On beginning my work as teacher of science in the public schools of this city I had planned that the teachers of the various schools should bring their classes to the Academy during the spring and fall to study such subjects as could be illustrated with objects from our museum, and that I give talks at the school buildings during the winter months. Had it been practicable to carry out this idea, as first contemplated, it would have taken up much less of the curator's time than under the present system. But the teachers of the outlying schools felt that it would be a hardship to bring classes, especially those of primary or intermediate grades, for such great distances. Under the present system, therefore, I visit each school once every three weeks during the fall and winter, giving from four to eight (usually five) lectures at each school during a single forenoon. My plan is to go from room to room, taking with me specimens from our museum for illustrating the lesson. In most of the schools I take the rooms two and two and am thus enabled to talk to from 250 to 400 pupils per day. During the months of May and June of the present year the Ninth Grades from the different schools were taken on excursions to the Government Island, one school at a time, for the purpose of studying the birds and their habits, and the Seventh and Eighth Grades were given lectures at Science Hall on our common wild flowers. These lectures were illustrated with stereopticon slides. After the lectures the classes were taken through the museum by their teachers. I believe the children are taking interest in this work, and it seems that the teachers and principals are willing that it should be continued. Yet I feel that there is much work accumulating at the Academy which is now neglected on account of want of time. It would not be well for the Academy to give up the lectures in the schools, nor can we longer postpone the work that should be done at the museum. It might be advisable to confer with the School Board regarding the employment of an assistant who would continue the lectures at the schools, thus allowing me once more to give full time to the Academy.

The Academy can be made still more helpful to the schools through the

preparation of loan collections, accompanied by study outlines, for use at the various schools. By coöperation with the School Board a series of illustrated lectures for children might be arranged, these to be given by local persons, admission being free. These free lectures to children are meeting with much favor in the museums of our larger cities.

Summary.

1.—Each school visited once in three weeks (forenoons).....	
2.—Number of lectures daily.....	5
3.—Number of lectures at schools during year.....	820
4.—Lectures to children, Science Hall, illustrated with lantern.....	4
5.—Excursions to Government Island for bird study.....	13
6.—Number of classes that visited the museum.....	26

EXPLORATIONS.

During the summer of 1906 the attention of the Academy was called to the groups of mounds in Whiteside county, Ill., not far from the town of Albany. After obtaining permission from the owners of the land on which the mounds are located, a number of expeditions were sent out. Two of the larger mounds were explored, resulting in some very interesting finds. A survey of the region is to be made during the present winter. After the material has been worked over a more complete report will be prepared.

DONATIONS.

The museum has increased rapidly in size and usefulness during the past five years. All this is due to the generosity of our numerous patrons and their pride in maintaining a good local museum. Very seldom is the Academy called upon to purchase a specimen for its collections. Almost our entire museum has grown up through donations. It is gratifying to know that a large percentage of the specimens in the Natural History department are brought in by children.

ACCESSIONS TO MUSEUM.

Geology	3 specimens
Paleontology	several hundred "
Botany	1 "
Zoölogy	20 "
History	3 "
American Archæology.....	240 "
American Ethnography	102 "
Miscellaneous.	10 "

VISITORS TO MUSEUM.

(See Appendix.)

The plan of opening the museum on the first Sunday of each month was begun in November, 1903, and is still continued.

ANNUAL ADDRESS OF THE PRESIDENT.

Members of the Academy, Ladies and Gentlemen—The year for which you honored me with the presidency of the Academy comes to a close with the present annual meeting. Glancing back over this year I am both gratified and impressed with the activity manifested by the association during that period—an activity which marks the year 1906 as a memorable one in the history of the institution.

The Academy during that year added 169 new names to its membership; it completed the publication of one volume of its proceedings and started upon the publication of another; it held many interesting and well attended meetings; it provided a regular course of lectures by noted scientists and

also a number of lectures by its own members; it continued its good work in the public schools; it attracted an increased number of visitors to its museum; it explored a number of mounds; it organized among its members a section for study and research; it rearranged and relabeled many of the collections of its museum; it added many new specimens to these collections and many volumes to its library; and it revised its constitution and by-laws to make them better serve its needs in its ambitious and far-reaching plans for the future.

Let me speak more in detail of the work of the Academy. During the year Volume X of its proceedings was practically completed. This volume as a whole will soon be ready for distribution. Besides a memoir to Mrs. Mary J. D. Putnam, it contains a biography of William Clement Putnam, and valuable papers by Prof. David Starr Jordan, Dr. Alfred Seale, Prof. Samuel Calvin, Prof. L. H. Pammel, Prof. T. D. A. Cockerell, Baron C. R. Osten Sacken, Prof. Walter J. Fewkes, Prof. Thomas H. Macbride, and Prof. C. C. Nutting. It is expected that Volume XI will be completed before the close of the present year. One of its parts, a valuable paper upon "The Protozoa of Iowa," by Charles H. Edmondson, is already out. In the publication of this and all future volumes the Academy changes the manner of publication of its proceedings. It issues the separate papers in pamphlet form and distributes them as soon as printed, leaving it to those who desire to keep the files intact to bind each volume when all the parts are complete. It is these publications of the Academy that carry its name and fame to all corners of the globe. It is these too that bring us in exchange valuable additions to our library.

During the year the Academy gave its usual annual course of lectures. This course proved to be one of the most successful in the history of the Academy. The lecturers were all authorities upon the subjects upon which they spoke, and several of them were men of international renown. The list included Prof. Samuel Calvin, Dr. Otto Nordenskjöld, Dr. Duren J. H. Ward, Prof. C. C. Nutting, Dr. John P. Peters, and Prof. Thomas H. Macbride. The attendance was uniformly large. Additional lectures were delivered at the monthly meetings of the association by H. E. C. Ditzen, A. F. Ewers, Prof. J. A. Udden, J. H. Paarmann, Prof. C. C. Nutting, and Dr. A. W. Elmer, all members of the Academy. These lectures, too, were well attended. Lectures by members will continue to be the feature of the monthly meetings of the Academy. Of this winter course of lectures, those by Prof. Charles H. Weller, of the University of Iowa, and Prof. R. G. Thwaites, Secretary of the Wisconsin Historical Society, have been already delivered. The remaining ones by Prof. Arthur P. Farwell, Prof. Frank G. Chapman, Prof. William Trelease, Prof. Samuel Calvin, Prof. T. H. Macbride, and Prof. Arthur Fairbanks will be delivered during January and February. Probably several more lectures will be added to this course. All these are free to members. The rule admitting its members free to all its lectures was adopted by the Academy in February. It met with much favor and continues in force.

The close and cordial relations which for years have existed between the Academy and the public schools were still further strengthened during the past year. The Academy's curator, J. H. Paarmann, delivered 820 lectures before classes from these schools in their respective classrooms during the school year. He addressed between 250 and 400 pupils daily, and used specimens brought from the Academy's museum to illustrate all his lectures. In addition, he delivered four illustrated lectures before classes from these schools, at Science Hall, escorted thirteen excursions to Government Island for bird study, and addressed many classes from the schools at the Academy, where with the aid of specimens from the museum he greatly increased the interest of the pupils in nature studies. Through the pupils whose interest in the Academy was thus awakened, their parents also became visitors and friends of that institution.

In order that the Academy may still further enhance its value as an educational factor, it should offer to hold its future regular lectures in the auditorium of the new high school and admit students of that school free to these lectures under such reasonable restrictions as its trustees may see fit to impose. Negotiations with this end in view should be opened with the Davenport School Board as soon as the new high school building is completed.

The cordial relations which have also long existed between the Academy and all other educational institutions of the three cities continue unchanged. Pupils from these institutions make free use of our museum and are at all times heartily welcome.

During recent years the Academy, through gifts and in exchange for its own publications, has received many additions to its library. The most important of the gifts were the library of Griswold College, presented by its trustees, and that of D. S. Sheldon, which, with many additional volumes, was presented by Miss Sarah Foote Sheldon. These gifts are highly appreciated. The books and pamphlets of our library now number 48,553. It is one of the most valuable scientific libraries west of Chicago.

During recent years the Academy, through gifts, also received many accessions to its museum. The most important of these were a large collection of baskets of Indian make and a large collection of stuffed native birds presented by W. C. Putnam shortly before his death; a large and valuable collection of animal heads and horns presented by Dr. D. D. Palmer; a collection of natural history specimens presented by Mrs. Anna Wuestenberg; a collection of marine invertebrates presented by Webb Ballard, and a collection illustrating the manufacture of pearl buttons presented by J. F. Boepple. Besides these there were received many welcome gifts of small collections and single specimens from other friends of the institution. To all of these donors the Academy feels itself deeply indebted.

Within the last few days the Academy has also received by gift a collection of Indian relics consisting of 1,200 specimens found in this vicinity. This collection was purchased from its owner and presented to the Academy by its president. Charles J. Beenck, who devoted twenty-five years to making this large and valuable collection of local Indian relics, and who either found these specimens himself or obtained them from those who found them, has rendered this community services for which great credit is due him. I suggest that he be presented with a life membership in the Academy in recognition of these services.

During the past year many of the collections of the Academy's museum were rearranged and supplied with descriptive labels that convey the maximum information regarding the specimens. This has added much to the scientific value of these collections. It has made them of greater service for study purposes and of greater interest to the general public. Special thanks are due to Miss Sarah Foote Sheldon and our curator for this work. The decision of the Academy, recently reached, to use Science Hall for museum purposes after the close of the present course of lectures, is a most commendable one. This will provide the much needed space for collections which heretofore could not be properly displayed. There is great need, however, of additional cases if these collections are to be displayed at their best. I hope to see these provided before the close of another year.

It is the aim of the present officials of the Academy to develop its museum on broad lines. While each museum should have its special features, as has ours in its collection of mound-builders' relics, and should also have a notable collection in some line and aim at completeness for this, that museum, nevertheless, will be of greatest benefit to the general public in which all lines are represented. When, therefore, the Academy shall once possess a spacious new museum building I hope to see not only rooms for anthropological, archaeological, geological and botanical collections, but also rooms for historical and art collections.

The number of visitors at the museum during the last year exceeded 6,000. This large attendance is most gratifying proof of the growing interest in the Academy's work. It is also proof of the wisdom of opening the museum to the public on the afternoon of the first Sunday of each month, and of granting free admission at such time as well as on certain week days.

The financial condition of the Academy continues most satisfactory. At its last annual meeting the association for the first time in its history found itself free from debt. It has remained so since and enters upon the new year with a surplus. However, its needs are many and it is hoped that the citizens of Davenport who, during the last thirty years through their liberal contributions made the Academy what it is, will continue to exercise toward it their usual liberality.

Last autumn the Academy resumed its old-time activity in search of light on the ever puzzling question, Who were the mysterious people who in pre-historic times built the myriads of mounds which are found along the Mississippi and its tributaries? The results of its explorations of mounds at Albany, Illinois, were magical. Not only were its discoveries of great scientific interest, but the Academy through these again became as much the center of interest of scientists the world over as it was when in earlier years it was active in exploring the Toolesboro and Cook Farm groups of mounds. Its fame is again spreading to all points of the compass. Given the exclusive privilege by the owners of the Albany group of mounds to explore these, the Academy confidently looks forward to further interesting discoveries that will doubtless throw additional light on the question whether their builders were the ancestors of the present day American Indians, or a race now extinct, or a people now represented only by descendants dwelling in regions remote from the early homes of their ancestors in the valley of the Mississippi.

During the last year a section for study and research was organized within the Academy. This is the most encouraging of all the signs of that institution's reawakening. Here at last is a united effort to aid the Academy in serving its highest purpose by making it the center of active scientific work. From the ranks of this section will come the men to whom in future years the Academy will entrust its highest interests. From it may also rise some future Agassiz or Audubon.

The most important matter affecting the Academy I have reserved for the last. It refers to William Clement Putnam's princely bequest. Under his will and as a memorial to his parents, Mr. Putnam left practically his entire fortune in trust for the benefit of the Davenport Academy of Sciences, to be used by it for the increase and diffusion of knowledge. Seldom have the savings of a lifetime been consecrated to nobler purposes than were those of Mr. Putnam when they were thus made subservient to science, art, and education. Generations of grateful people will carry the name of William Clement Putnam, philanthropist, down through the centuries until the end of time. Let me here once more record our deep sense not only of Mr. Putnam's noble gift, but also of the confidence he reposed in the Academy when he chose it as the instrument for carrying out his high purposes.

Through this bequest the year 1906 is marked as that of the beginning of the renaissance of this institution. Henceforth its ambition will soar to heights never dreamed of by its founders. Let us bear in mind, however, that only that is destined to endure which is carefully planned and is made to rest on solid foundations. It is meet, therefore, that we proceed with the deliberation due the important work in hand. But when once the Academy's carefully-to-be-considered plans for the future shall have been fully matured, its progress in placing itself in the front rank of America's scientific institutions will be by leaps and bounds.

Doubtless you would be glad to know how long it will be until the corner-stone for the new fire-proof museum building, for which there is great

need, and for the erection of which Mr. Putnam provides in his will, can be laid. We hope it will not be many years. Mr. Putnam, with the object of making his estate further in the greatest measure the purposes for which it was given, left specific instructions regarding its management. But the trustees charged with carrying out these instructions are also given certain discretionary powers. Inasmuch as these trustees are themselves most warmly attached to the institution which was so near the heart of Mr. Putnam, the members of the Academy may well feel that its interests are in the best of hands. They may rest assured that the discretionary powers will be wisely exercised, and that funds for the erection of the new museum building, and for the development of the institution in compliance with the wishes of Mr. Putnam, will be made available as speedily as the best interests of the Academy will permit.

Meanwhile, officers, trustees and members of the Academy, it behooves us to relax none of our efforts to advance, and to guard jealously, the interests of this institution while they are entrusted to our care.

APPENDIX.

ACCESSIONS TO THE MUSEUM.

1904-1906.

All accessions are by gift. Donors are citizens of Davenport unless otherwise noted.

GEOLOGY.

Baker, Charles J.,	Specimens of wolframite, antimony, and uranium from the Black Hills.
Collister, Clayton.....	2 fossil crinoids, Quarry, Iowa.
Edwards, Allan	Fossil, Montana.
Gronen, W. O.	Copper ore, petrified wood.
Hammatt, E. S.	Collection of fossils.
Harrison, E. R.	Minerals, Jackson county, Mont.
Petersen, A.	Ammonite.
Petersberger, Isaac.	57 specimens of rocks.
Putnam, Miss E. D.	Trilobites.
Putnam, W. C.	Ichthyosaurus, ammonites sp., Charmouth, Dorset, England; 10 specimens of native copper, 2 of iron ore, 1 of lead ore, Michigan.
Rumsey, Byron.....	Geological specimen.
Smith, Mrs. S. F.	Minerals, Colorado.
Wuestenberg, Mrs. Anna.....	40 specimens of rocks.

ZOÖLOGY AND BOTANY.

Auerochs, May.....	Wilson's Thrush.
Ballord, E. S.	2 skunk skins.
Bechtel, Harold	Rabbit, young.
Berwald, Walter.	Little Green Heron, Pleasant Valley, Iowa.
Blair, Burdette.....	Cedar Waxwing.
Brouse, Charles, and Van Patten,	
Herbert.....	Muskrat.
Brown, Mabel A.	Golden-crowned Kinglet.
Burns, Mrs. Mattie.....	Hornet's nest.

- Burrows, Mrs. P. T..... Snowy Owl, mounted.
 Busch, Ralph Gray-checked Thrush, Rose-breasted Gros-
 beak ♀, Davenport.
 Elmer, Dr. A. W..... Myrtle Warbler ♀, Davenport.
 Ficke, C. A..... 54 birds, mounted and labelled, Japan; 2 Leaf
 Insects, East Indies; 46 specimens of coral,
 Singapore.
 Goodwin, Mabel..... Wilson's Thrush, Davenport.
 Harrison, C. E..... Centipede, nest of Trap-door Spider, horn of
 Swamp Ox, India, used as a container for
 civet.
 Hilmers, Carl..... Sora Rail, Davenport.
 Houdek, Mrs. R..... Shell containing 3 Mississippi River pearls.
 Hubbell, Lawrence..... Fox Sparrow, Davenport.
 King, J. D..... Deep sea shells.
 Koehler, Mrs. Henry..... Stem and beans of coffee tree.
 Kunz, Ben Woodchuck, Davenport.
 McCune, C. A..... Ring-necked Pheasant, Oregon.
 Mandeville, Miss A. L..... Wood Duck; Willow Ptarmigan, Colorado;
 group of Bobwhite, pair of Bobwhite, pair of
 Woodcock, Baltimore Oriole, Egret, Flying
 Squirrel, Scott county, Iowa; Valley Part-
 ridge, California.
 Mengel, William Black-crowned Night Heron.
 Muxfeldt, Henry..... Cardinal, Ont.; Lamprey eel, St. Lawrence
 River.
 Nagel, R..... Rabbit, abnormal.
 Nelson, George..... 40 sets of bird's eggs.
 Palmer, D. D. and B. J..... 42 mounted mammal heads; 147 mounted
 pairs of horns; 5 Rhinoceros horns; 1 pair
 Giraffe horns; Walrus skull; Walrus tusk;
 Six-banded Armadillo, mounted; Squirrel,
 mounted; Wapiti; whalebone; two saws of
 Sawfish; Mastodon tusk, Alaska; Babirussa
 skull, Borneo; Lobster, mounted; Giant
 Clam, East Indies; 2 Narwhal tusks.
 Pammel, Prof. L. H., Ames, Iowa, 50 common weeds of Iowa, mounted and
 labelled; 32 specimens of wood (sections of
 tree trunks), Iowa.
 Parry, Mrs. C. C..... Ferns.
 Peto, F. E..... Snake, in alcohol, Florida.
 Ploehn, Camilla..... Oven Bird, Davenport.
 Priester, Adolph..... Collection of insects, mostly butterflies.
 Putnam, E. K..... Botanical specimens, California; pine cones
 from the Sierra Nevada.
 Putnam, Mrs. E. K..... Trout, mounted, Sweden.
 Putnam, W. C..... Kallima Butterfly, India; Purple Heron,
 Europe.
 Raabe, John..... Yellow-bellied Sapsucker, Davenport.
 Schlessmann, Barbara Long-billed Marsh Wren, Davenport.
 School No. 1 Mourning Warbler ♀, Davenport.
 School No. 4 Nashville Warbler ♀, Sora Rail, Davenport.
 School No. 10..... Nashville Warbler ♀, Davenport.
 Spring, Fred..... Cape May Warbler, Davenport.
 Stafford, Charles..... Ovenbird, White-throated Sparrow, Daven-
 port.
 Truckenmiller, Charles Bay-breasted Warbler, Yellow Warbler, Day-
 enport.
 True, Edgar..... Golden-crowned Kinglet ♂, Davenport.

Valerius, Oscar.....	Flying Squirrel, Davenport.
Voelkers, Lawrence.....	Golden-crowned Kinglet ♀, Davenport.
Vollmer, Harry.....	Canadian Warbler, Davenport.
White Yard, The.....	Specimens of Curly White Pine and Curly Yellow Pine lumber.
Wuestenberg, Mrs. Anna.....	20 specimens of coral, 5 Starfish, 206 shells, alligator, young, mounted.
Wundram, Oscar.....	Golden-crowned Kinglet ♀, Davenport.

ANTHROPOLOGY.

Bronner, Miss Anna.....	Stone gorget, Erie county, New York.
Fisher, Francis J., Chicago, Ill.,	Mummified hawk from the tombs of Abydos, Egypt.
Grabbe, Charles.....	157 arrow and spear heads.
Haase, William.....	8 stone implements from near Fox Lake, Minnesota.
Harrison, C. E.....	Discoidal stone, Carrollton, Ky.
Kempker, Rev. J. F.	Arrowheads.
Koehler, Mrs. Henry.....	Tapa cloth.
Moore, Clarence B.....	62 shell implements, 10 perforated shells, 34 wrought shells, Marco, Florida.
Muenchow, J. F.....	Copper ax.
Petersberger, Isaac.....	Spearhead.
Plummer, Edwin V.....	Zulu war club, Africa.
Putnam, Miss E. D.....	5 pieces of Mexican pottery, modern; Sulu garment; Eskimo throwing stick; sample of Navajo weaving.
Putnam, E. K.....	12 specimens of the work of the Washoe and Paiute Indians of Nevada; stone ax.
Putnam, G. R.....	Native straw hats, Philippines.
Putnam, W. C.....	102 Indian baskets.
Tucker, Harvey, Albany, Ill.,	Shell vessel and potsherds from mound No. 71 at Albany, Ill.
Wuestenberg, Mrs. Anna.....	36 stone axes, 2 pestles, chipped-stone hoe, 9 articles of polished stone, 6 sets shell beads, 275 arrow and spear heads, 6 flint perforators.

MISCELLANEOUS.

Boepple, J. F.....	Exhibit to illustrate pearl button industry.
Burmeister, Walter.....	Candlestick, 150 years old; pocket-knife, 200 years old; seal, old-fashioned, Germany.
Duncan, Joseph.....	Chest of carpenters' tools.
Harrison, C. E.....	"Panorama of Davenport in the year 1872," photograph of oil paintings of Fort Armstrong, Rock Island; 4 other historical relics.
Naeckel & Sons.....	Exhibit to illustrate process of making white lead.
Mueller, A. O.....	Burmese prayer-book; Chinese back-scratcher; model boat of birch bark; historical specimens, Michigan.
Rindler, Dr. A.....	Japanese muscle roller (for massage).
Sheldon, Miss S. G. F....	Cases for exhibiting and storing shells; 5 dozen frames, with glass, for mounting butterflies for study.
Spink, Mrs. Henry.....	Chinese hat; Night lamp and food warmer, England.
Whitaker, Charles.....	Carding combs for cotton, pair of holsters.
Wuestenberg, Mrs. Anna.....	20 miscellaneous articles.

VISITORS TO THE MUSEUM.

The museum is open to the public from 1 to 5 P. M. every week day and from 1:30 to 5 P. M. on the first Sunday in each month.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1904	250	450	1119	1262	722	660	138	148	1008	910	486	137	7290
1905	305	427	1440	1329	1058	1589	320	480	580	490	442	387	8847
1906	446	468	538	515	175	1420	230	180	190	287	592	378	5419

The figures given are taken from the visitors' register and, as many visitors do not register their names, these figures are only approximately correct. This is especially true for 1906, when the attendance was probably larger than ever.

ACCESSIONS TO LIBRARY, 1904-1906.

BY GIFT

Bowman, Dr. E. S.	1
Burns, Mrs. M.	4
Decker, Miss Frances S.	20
Democrat Co.	285
Durfee, Mrs.	2
Eads, L. T.	2
Gould, Miss Ellen	1
Kempker, Rev. J. F.	2
Leader Co.	45
Plummer, C. G.	3
Preston, Dr. C. H.	12
Putnam, Miss E. D.	11
Sanders, Miss J. E.	12
Sheldon, Miss S. G. F.	13
Whitaker, Charles	2
Wuestenberg, Mrs. Anna.	21

Total books 436

By purchase 40 books

By exchange 3,761 accessions (incl. pamphlets)

LECTURES, 1904-1907.

LECTURE COURSE, SEASON 1903-1904.

- January 4, 1904. Dr. L. O. Howard, Washington, D. C., "Some Interesting Features of Insect Life."
 January 11, 1904. Prof. C. C. Nutting, University of Iowa, "Protective Coloration Among Animals."
 January 18, 1904. Prof. Thomas H. Macbride, University of Iowa, "Alamogordo—a Problem of the Desert."
 January 25, 1904. Prof. Charles S. Magowan, University of Iowa, "Sanitary Engineering."
 February 1, 1904. Prof. Bohumil Shimek, University of Iowa, "Man in the Tropics."
 February 8, 1904. Prof. A. A. Veblen, University of Iowa, "Ancient Ship Building in Northern Europe."
 February 15, 1904. Prof. Samuel Calvin, University of Iowa, "The Geology and Scenery of the Pipestone Region."

SEASON 1904-1905.

- October 31, 1904. Prof. Thomas H. Macbride, "The Plant Responsive to Human Preference."
 November 7, 1904. S. P. Verner, St. Louis, Mo., "Adventures and Studies Among the African Pigmies."
 November 14, 1904. Prof. Bohumil Shimek, University of Iowa, "The Use and Abuse of Trees."
 November 21, 1904. Prof. C. C. Nutting, University of Iowa, "The Alaskan Fur Seal."
 November 28, 1904. Prof. Samuel Calvin, University of Iowa, "A Geological Excursion Among the Rockies of Colorado."
 December 5, 1904. Prof. Laenas G. Weld, University of Iowa, "Life History of a Star."

ADDITIONAL LECTURES.

- January 19, 1905. Charles S. Lummis, Los Angeles, California, "The Primitive Songs of the Southwest," given with the coöperation of the Archæological Institute of America.
 February 12, 1905. W J McGee, Washington, D. C., "Fire, Knife and the Wheel."
 November 24, 1905. C. A. Ficke, Davenport, "Japan."

SEASON 1905-1906.

- January 15, 1906. Prof. Samuel Calvin, University of Iowa, "Vulcanism and Related Phenomena in the Yellowstone National Park."
 January 26, 1906. Dr. Otto Nordenskjöld, Sweden, "Two Years Amongs the Ice of the South Pole."
 February 5, 1906. Dr. Duren J. H. Ward, Iowa City, Iowa, "Our Iowa Indians, the Meskwakis of Tama County."
 February 12, 1906. Prof. C. C. Nutting, University of Iowa, "Marine Investigation on the Coast of Southern California."
 February 19, 1906. Dr. John P. Peters, New York, "The Pennsylvania Expeditions to Babylon."
 February 26, 1906. Prof. Thomas H. Macbride, University of Iowa, "Luther Burbank and His Garden."

ADDITIONAL LECTURES.

- March 15, 1906. Dr. Alfred M. Tozzer, Harvard University, "Central American Archæology," given with the coöperation of the Archæological Institute of America.
 December, 1906. Prof. C. H. Weller, University of Iowa, "Here and There in Greece," given with the coöperation of the Archæological Institute of America.
 November 30, 1906. Prof. C. C. Nutting, University of Iowa, "The Function of the Provincial Museum."

LIST OF PRESIDENTS

OF THE

DAVENPORT ACADEMY OF SCIENCES.

D. S. Sheldon.....	December 14, 1867 to	October 9, 1868.
C. C. Parry	October 9, 1868, to.....	January 9, 1875.
E. H. Hazen.....	January 9, 1875, to.....	January 5, 1876.
W. H. Barris.....	January 5, 1876, to.....	January 3, 1877.
S. S. Hunting.	January 3, 1877, to.....	January 25, 1878.
R. J. Farquharson.....	January 25, 1878, to.....	January 1, 1879.
Mrs. Mary L. D. Putnam.	January 1, 1879, to.....	January 7, 1880.
W. H. Pratt.....	January 7, 1880, to.....	January 5, 1881.
J. Duncan Putnam	January 5, 1881, to his death...	December 10, 1881.
C. H. Preston	January 4, 1882, to.....	January 3, 1883.
E. P. Lynch	January 3, 1883, to.....	January 2, 1884.
H. C. Fulton.	January 2, 1884, to.....	January 7, 1885.
C. E. Putnam	January 7, 1885, to.....	January 26, 1887.
C. E. Harrison.....	January 26, 1887, to.....	January 16, 1889.
Miss Jennie McCowen .	January 16, 1889, to.....	January 7, 1891.
James Thompson	January 7, 1891, to his death ..	February 11, 1892.
W. L. Allen.....	February 11, 1892, to	January 2, 1895.
E. S. Hammatt.....	January 2, 1895, to.....	January 18, 1899.
Charles Francis	January 18, 1899, to.....	January 5, 1900.
Mrs. Mary L. D. Putnam.	January 5, 1900, to her death...	February 20, 1903.
A. W. Elmer.....	February 20, 1903, to	January 10, 1906.
C. A. Ficke.....	January 10, 1906, to	

ELECTIONS TO MEMBERSHIP.

January 29, 1904—December 31, 1906.

HONORARY MEMBERS.

Gifford Pinchot, Washington, D. C.	January, 1905
Charles F. Lummis, Los Angeles, California	January, 1905
Otto Nordenskjöld, Gothenburg, Sweden	January, 1906

CORRESPONDING MEMBERS.

F. J. Becker, Iowa City, Iowa	March, 1904
Harlan I. Smith, New York, N. Y.	September, 1904
Joseph Zawodny, Prague, Austria.	December, 1905
Cleveland Abbe, Washington, D. C.	May, 1906
E. L. Lefebure, Cedar Rapids, Iowa	September, 1906
S. A. Maxwell, Morrison, Illinois	November, 1906

REGULAR MEMBERS.

(Residence Davenport, unless otherwise stated.)

Ditzen, Henry E. C.	January, 1904	Donahue, Mrs. J. P.	February, 1906
Brugman, John J.	February, 1904	Donald, Gustav	" "
Lau, Charles W.	" "	Donegan, M. F.	" "
Udden, J. A., Jr., Rock		Downer, H. E.	" "
Island, Ill.	September "	Dueser, F. H.	" "
Cable, Mrs. Ben T.,		Evans, S. J.	" "
Rock Island, Ill.	January, 1905	Evans, T. J.	" "
Davison, Donald	" "	Farrand, Willis	" "
Decker, Miss F. S.	February, "	Ficke, E. O.	" "
Ells, Miss Louise	" "	Ficke, G. H.	" "
Lambach, Fred H.	" "	Ficke, Miss Helen.	" "
Glueck, Fred, Jr.	December, "	Ficke, R. C.	" "
Beenck, J. C.	January, 1906	Fidlar, W. F.	" "
Atkinson, Arthur.	February, "	Fisher, L. M.	" "
Atkinson, Mrs. Arthur	" "	Friedholdt, B. C.	" "
Baldwin, J. R.	" "	Gehrmann, W. H.	" "
Banning, G. W.	" "	Grilk, Charles.	" "
Birchard, C. E.	" "	Guldner, Ludwig F.	" "
Block, Louis.	" "	Haase, William	" "
Bräunlich, Henry.	" "	Haase, Mrs. William.	" "
Burch, Ira C.	" "	Haight, W. K.	" "
Burrows, P. T.	" "	Hall, J. C.	" "
Burrows, Mrs. P. T.	" "	Harkness, G. F.	" "
Bushnell, Horace T.	" "	Hartz, H. W.	" "
Calkins, J. E.	" "	Hartz, Theo.	" "
Campbell, L. R.	" "	Hayward, A. W.	" "
Carstens, L. P.	" "	Hecht, J. L.	" "
Cole, F. L.	" "	Hetzel, C. C.	" "
Collins, Edward.	" "	Hornby, J. A.	" "
Cram, Ralph W.	" "	Huber, C. S.	" "
Crouch, Fred A.	" "	Humphrey, W. W.	" "
Crouch, Mrs. Fred A.	" "	Jacobs, J. H.	" "
Davis, J. J.	" "	Jennings, W. H.	" "
Decker, G. E.	" "	Kaufmann, Ed.	" "
Dilworth, W. H., Rock		Kellogg, C.	" "
Island, Ill.	" "	Kemmerer, C. T.	" "
Donahue, J. P.	" "	Kemmerer, T. W.	" "

Koehler, Herbert O.	February, 1906	Creswell, Miss Grace.	March, 1906
Krohn, Hugo	" "	Ditzen, Julius	" "
Kulp, Ray R.	" "	Dixon, E. W.	" "
Ladenberger, Otto L.	" "	Dixon, Mrs. E. W.	" "
Lischer, Fred A.	" "	Giglinger, G.	" "
Lischer, Oscar	" "	Goenne, E. C.	" "
Lowary, O. H.	" "	Hartz, B. C., Rock	" "
McCandless, C. R.	" "	Island, Ill.	" "
McCullough, W. J.	" "	Hornby, Ben H.	" "
McIntyre, C. C.	" "	Kerker, H. W.	" "
Marks, M. L.	" "	Kerker, Mrs. H. W.	" "
Martin, Wellington H.	" "	Mann, Otto	" "
Meyer, C., Jr.	" "	Mueller, Alfred C.	" "
Meyer, Edward U.	" "	Nabstedt, Henry	" "
Middleton, George	" "	Nabstedt, J. M.	" "
Nagel, J. J.	" "	Riepe, Adelbert	" "
Nagy, B. A.	" "	Rothschild, Mrs. M.	" "
Nutting, J. R.	" "	Silberstein, Emil	" "
Nutting, Mrs. J. R.	" "	Silberstein, Louis	" "
Ochs, Joseph	" "	Silberstein, Martin	" "
Otis, E. L.	" "	Silberstein, Max	" "
Ottesen, Realf.	" "	Smith, J. J.	" "
Parsons, Alfred	" "	Smith, Mrs. J. J.	" "
Petersen, Adolph	" "	Whitaker, Byron	" "
Phillips, C. E.	" "	Whitaker, Miss Edna	" "
Pierce, S. W.	" "	White, I. S., Rock	" "
Porter, J. R.	" "	Island, Ill.	" "
Preston, Charles I.	" "	Austin, John	April, 1906
Redfield, R. P.	" "	Berger, Fred	" "
Richter, August	" "	Borcherdt, Miss Olga	" "
Robeson, C. E.	" "	Billstein, Miss Stella	" "
Rothschild, Moses	" "	Brandt, Miss Clara L.	" "
Rudolf, F. E.	" "	Brown, Miss Mary	" "
Schaefer, J. H.	" "	Ells, Louise	" "
Sears, I. H.	" "	Engelhardt, R. R.	" "
Sherier, J. W.	" "	Hansen, Martin B.	" "
Smith, Martin H.	" "	Hass, Leon H.	" "
Stibolt, V. A.	" "	Henley, Mrs. Ella V.	" "
Stolle, W. J.	" "	Kersch, Paul, Rock	" "
Suksdorf, C. L.	" "	Island, Ill.	" "
Temple, S. J.	" "	Koch, G. H.	" "
Vincent, C. S.	" "	Melville, Mrs. M. E.	" "
Vollmer, Arthur	" "	Plummer, Charles G.	" "
Vollmer, Karl	" "	Putnam, Mrs. E. K.	August 1906
Wadsworth, Mrs. W. C.	" "	Brockmann, John	November, "
Waldman, George L.	" "	Godfrey, N. L.	" "
Walker, F. J.	" "	Godfrey, Mrs. N. L.	" "
Wallace, A. S.	" "	Eldredge, Miss G. M.	" "
Watzek, Mrs. J. W.	" "	Harrison, Mrs. F. E.	" "
Weir, W. R.	" "	McCartney, G. S., Al-	" "
Weir, Mrs. W. R.	" "	bany, Ill.	" "
Wells, W. D.	" "	Silberstein, Mrs. Martin	" "
Williams, H. L.	" "	Smart, F. L.	" "
Yaggy, L. J.	" "	Thomas, Miss Emma	" "
Bowman, E. S.	March, 1906	Wiswell, Mrs. F. J.	" "
Bush, A. G.	" "	Gast, A. E.	December, 1906
Carmichael, Joe	" "	Green, William	" "
Carstens, H. A.	" "		

MEMBERS OF THE DAVENPORT ACADEMY OF SCIENCES.

HONORARY MEMBERS.

Andrews, Launcelot W.	St. Louis, Missouri
*Baird, Spencer F.	Washington, D. C.
Billings, John Shaw	New York City, New York
Calvin, Samuel	Iowa City, Iowa
*Candolle, Alphonse	Geneva, Switzerland
*Carpenter, W. B.	London, England
*Etheridge, Robert	South Kensington, England
Fernow, Bernhard E.	Ithaca, New York
*Gray, Asa	Cambridge, Massachusetts
*Hagen, H. A.	Cambridge, Massachusetts
*Henry, Joseph	Washington, D. C.
Holmes, William Henry	Washington, D. C.
Hooker, Joseph D.	Kew, England
Howard, Leland O.	Washington, D. C.
Jordan, David Starr	Stanford University, California
*Kirtland, J. P.	Cleveland, Ohio
*LeConte, J. J.	Philadelphia, Pennsylvania
Loubat, Duc de	Paris, France
Lummis, Charles F.	Los Angeles, California
Macbride, Thomas H.	Iowa City, Iowa
Moore, Clarence B.	Philadelphia, Pennsylvania
*Nadaillac, Marquis de	Paris, France
Nordenskjöld, Otto	Gothenburg, Sweden
Nutting, Charles C.	Iowa City, Iowa
Osborn, Herbert	Columbus, Ohio
*Osten Sacken, C. R.	Heidelberg, Germany
Pinchot, Gifford	Washington, D. C.
Pritchett, Henry S.	New York, New York
Putnam, Frederick W.	Cambridge, Massachusetts
Starr, Frederick	Chicago, Illinois
*Westwood, J. O.	Oxford, England
White, Charles A.	Washington, D. C.

* Deceased.

CORRESPONDING MEMBERS

Abbe, Cleveland	Washington, D. C.
Abbott, Charles C.	Trenton, New Jersey
Agassiz, Alexander	Cambridge, Massachusetts
Allen, Joel A.	New York, New York
Andreen, Gust. A.	Rock Island, Illinois
Andrews, Edmund	Chicago, Illinois
Arthur, Joseph C.	Lafayette, Indiana
Atwood, H. F.	Rochester, New York
Ball, Elmer D.	Logan, Utah
Ballou, W. H.	New York, New York
Barcena, Mariano	Mexico, Mexico
Barnes, W. D.	Morgan Park, Illinois
Barrois, Charles	Lille, France
Beach, Miss Alice	Urbana, Illinois
Becker, F. J.	Iowa City, Iowa
Bessey, Charles E.	Lincoln, Nebraska
Bethune, Charles J. S.	Guelph, Ontario, Canada

Blatchford, E. W.	Chicago, Illinois
Boehm, W. M.	
Brandigee, T. S.	San Diego, California
Brendel, Emil.	Cedar Rapids, Iowa
Brendel, Fred.	Peoria, Illinois
Broadhead, Garland C.	Columbia, Missouri
Burgess, Edward S.	New York, New York
Butler, J. D.	Madison, Wisconsin
Byers, W. N.	Denver, Colorado
Canby, William M.	Wilmington, Delaware
Carr, Lucien	Cambridge, Massachusetts
Caton, J. D.	Ottawa, Illinois
Channon, Irving M.	Kusaie, Caroline Islands
Chapman, W. Albert	Smithville, Lawrence Co., Ark.
Claypole, Edward W.	Akron, Ohio
Cleveland, Daniel	San Diego, California
Cockerell, Theodore D. A.	Boulder, Colorado
Comstock, J. Henry	Ithaca, New York
Comstock, Theodore B.	Los Angeles, California
Condon, Thomas	Portland, Oregon
Cook, Albert J.	Claremont, California
Coulter, John Merle	Chicago, Illinois
Cowan, Frank	Greensburg, Pennsylvania
Cox, Lisbon A.	Keokuk, Iowa
Crampton, Charles A.	Washington, D. C.
Cresson, Ezra T.	Philadelphia, Pennsylvania
Dall, William H.	Washington, D. C.
Dodge, Charles Richards	Washington, D. C.
Edwards, William H.	Coalburgh, West Virginia
Egan, W. C.	Highland Park, Illinois
Eliot, T. L.	Portland, Oregon
Emerton, James H.	Boston, Massachusetts
Engelmann, George J.	Framingham, Massachusetts
Farlow, William G.	Cambridge, Massachusetts
Farnsworth, Philo J.	Clinton, Iowa
Forbes, S. A.	Urbana, Illinois
Gentry, Thomas G.	Philadelphia, Pennsylvania
Gill, Theodore N.	Washington, D. C.
Goodale, George L.	Cambridge, Massachusetts
Greene, Edward L.	Washington, D. C.
Haworth, Erasmus	Lawrence, Kansas
Hill, Ellsworth J.	Chicago, Illinois
Hinrichs, Gustavus	St. Louis, Missouri
Iles, Malvern W.	Los Angeles, California
Ingersoll, Ernest	New York, New York
Jones, Joseph	
Kempker, John F.	Davenport, Iowa
King, J. D.	
Kock, Carl Ludwig	Nürnberg, Germany
Lefebure, E. Lucas	Cedar Rapids, Iowa
Lemmon, John Gill	Oakland, California
Leverett, Frank	Ann Arbor, Michigan
Lindahl (Johan Harald) Josua	Cincinnati, Ohio
Lingle, David J.	Chicago, Illinois
Lintner, J. A.	Albany, N. Y.
McCook, Henry C.	Devon, Pennsylvania
McGee, WJ	St. Louis, Missouri
McLean, J. P.	Greenville, Ohio

McNeill, Jerome	Richmond, Indiana
Mann, B. Pickman.....	Washington, D. C.
Mark, Edward L.....	Cambridge, Massachusetts
Mason, Otis T.....	Washington, D. C.
Maxwell, S. A	Morrison, Illinois
Meehan, T.	Philadelphia, Pennsylvania
Morse, Edward S.....	Salem, Massachusetts
Nipher, Francis E.....	St. Louis, Missouri
Patterson, H. N	Oquawka, Illinois
Peckham, George W.....	Milwaukee, Wisconsin
Peet, Stephen D.....	Chicago, Illinois
Philippi, R. A.....	Santiago, Chili
Pigeon, Mrs. J. C. D.....	Roxbury, Massachusetts
Ridgway, Robert.....	Washington, D. C.
Sanchez, Jesus	Mexico, Mexico
Saunders, William	Ottawa, Canada
Saussure, Henri de	Geneva, Switzerland
Scudder, Samuel H.....	Cambridge, Massachusetts
Shaw, James B	Decatur, Illinois
Shimek, Bohumil.....	Iowa City, Iowa
Simon, Eugene	Paris, France
Simpson, Charles T.....	Lemon City, Florida
Smith, Harlan I.....	New York, New York
Smith, Sidney I.....	New Haven, Connecticut
Snow, Francis H.....	Lawrence, Kansas
Stearns, Robert E. C.....	Los Angeles, California
Tandy, M.....	Dallas City, Illinois
Thomas, Cyrus.....	Washington, D. C.
Thorell, T. T. T.....	Upsala, Sweden
Tracy, Samuel M.....	Biloxi, Mississippi
Trimen, Roland.....	England
Uhler, Philip R.....	Baltimore, Maryland
Ulke, Henry.....	Washington, D. C.
Velie, J. W.....	St. Joseph, Michigan
Verrill, Addison E.....	New Haven, Connecticut
Villada, Manuel.....	Mexico, Mexico
Vining, Edward P.....	San Francisco, California
Ward, Henry A.....	Rochester, New York
Webster, Charles.....	Charles City, Iowa
White, A. D.....	Ithaca, New York
Whitfield, Robert P.....	New York, New York
Wickham, Henry F.....	Iowa City, Iowa
Wilder, Burt G.....	Ithaca, New York
Winchell, Newton H.....	Minneapolis, Minnesota
Witter, F. M.....	Muscatine, Iowa
Zawodny, Joseph.....	Prague, Austria

LIFE MEMBERS.

(Residence Davenport, unless otherwise stated.)

Adams, Mrs. Mary P.	Iles, Thomas, Jr.
Andresen, Richard	Leonard, Miss Eleanor E.
Balch, Frank A.	Lindsay, James E.
Ballord, Miss Elizabeth W.	McClelland, Mrs. Anna M.
Ballord, Webb	McClelland, Wilson
Beenck, J. C.	Morrison, Theodore N.
Berger, Edward	Mueller, Frank W.
Best, Louis P.	Paarmann, J. Herman
Burdick, Anthony	Parry, John E., New York
Cable, George W.	Pendleton, Mrs. E. H., Cincinnati, O.
Cable, George W., Jr.	Phelps, Mrs. Cornelia R.
Crossett, Edward S.	Putnam, Benj. R., Redding, Cal.
Crossett, Edward C.	Putnam, Charles M., Huron, S. D.
Cutter, Amos F.	Putnam, Edward K.
Davis, Frank O.	Putnam, Miss Elizabeth D.
Davison, Miss Ella	Putnam, George R., Washington, D.C.
Donaldson, John B.	Putnam, H. St. Clair, New York
Elmer, Albert W.	Renwick, William G., California
Ficke, Charles August	Richardson, Jenness J.
Ficke, Mrs. Charles August	Richardson, Mrs. Emma A.
Ficke, Miss Alice	Roberts, Edward C.
Ficke, Arthur D.	Roberts, Mrs. Julia A.
French, George W.	Robinson, Mrs. J. F., Rock Island, Ill.
French, Mrs. George W.	Roddewig, Paulo
French, Nathaniel	Rothschild, Isaac
Grant, Mrs. Elizabeth L.	Sheldon, Miss S. G. F.
Griggs, Francis H.	Torry, Mrs. Henry, Cambridge, Mass.
Haak, Ferdinand	Vollmer, Henry
Hall, Channing	Whitaker, Mrs. Lottie H.
Harrison, Charles E.	

REGULAR MEMBERS.

(Residence Davenport, unless otherwise stated.)

Allen, W. L.	Brockmann, John
Atkinson, Arthur	Brown, Miss Mary
Atkinson, Mrs. Arthur	Brugman, John J.
Austin, John	Bryan, Miss Gertrude W.
Baker, Charles R.	Burch, Ira C.
Baker, George T.	Burrows, Parke T.
Baldwin, J. Robert	Burrows, Mrs. Parke T.
Ballord, Esek S.	Bush, Arthur G.
Banning, George W.	Bushnell, Horace T.
Bechtel, George M.	Cable, Mrs. Ben T., Rock Island, Ill.
Bemis, Fred P.	Calkins, Jason E.
Berwald, John	Carmichael, Joe
Bettendorf, William P.	Carstens, Harry A.
Billstein, Miss Stella	Carstens, Louis P.
Birchard, Charles E.	Cole, Fred L.
Block, Louis	Collins, Edward
Borcherdt, Edward	Cram, Ralph W.
Borcherdt, Miss Olga	Creswell, Miss Grace
Bowman, Edward S.	Crossett, Mrs. Edward S.
Brandt, Miss Clara L.	Crouch, Fred A.
Bräunlich, Henry	Crouch, Mrs. Fred A.

- Davis, James J.
 Davison, Donald B.
 Decker, Miss Frances S.
 Decker, George F.
 Dilworth, W. H., Rock Island, Ill.
 Ditzen, Henry E. C.
 Ditzen, Julius
 Dixon, Edward W.
 Dixon, Mrs. Edward W.
 Donahue, James P.
 Donahue, Mrs. James P.
 Donald, Gustav
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ARTICLES OF INCORPORATION
OF THE
DAVENPORT ACADEMY OF SCIENCES.

As amended December 28, 1906.

Article I.—NAME AND OBJECT.

Section 1.—This Society shall be known as THE DAVENPORT ACADEMY OF SCIENCES and shall have for its objects the increase and diffusion of a knowledge of, and the encouragement of an interest in the arts and sciences, by the establishment of a museum, art gallery, and library, by the reading and publication of original papers, and by other suitable means.

Article II.—MEMBERS.

Section 1.—This Society shall consist of regular, honorary, and corresponding members, who shall be elected in such manner as the by-laws may prescribe.

Section 2.—The right of voting and holding office shall be confined to regular members, but honorary and corresponding members shall be entitled to all other privileges.

Article III.—OFFICERS AND TRUSTEES.

Section 1.—The officers of the Academy shall consist of a President, Vice-President, Secretary, and Treasurer.

Section 2. The President, Secretary, and Treasurer, with nine (9) other members, shall form a Board of Trustees for the management of the business of the Academy, and to conduct its proceedings, and a majority of such members shall constitute a quorum for the transaction of business.

Section 3.—The officers, and three members of the Board of Trustees to serve three years, shall be elected at the annual meeting on the second Tuesday of January in each year, and must receive a majority of the votes cast. In case of a vacancy, caused by the death or resignation of any officer or trustee, the Trustees shall fill the same.

Article IV.—ACQUISITION AND MANAGEMENT OF PROPERTY.

Section 1.—The Academy may receive, hold, and manage all property acquired by gift or purchase necessary or proper to promote its objects.

Section 2.—The Board of Trustees shall be empowered to purchase real estate and to make such improvements thereon as it deems necessary or proper to promote the objects of the Academy, but no such property of the Society shall be sold except in accordance with an affirmative vote of a majority of the Board of Trustees, ratified by a majority of the members of the Society present at a special or business meeting held after due notice given, specifying the objects thereof.

Article V.—BY-LAWS.

Section 1.—The Board of Trustees shall have the power to make all needful by-laws, rules, and regulations for the purpose of carrying out the objects of the Society and conducting its affairs, and not inconsistent with the Articles of Incorporation.

Article VI.—AMENDMENTS.

Section 1.—The provisions of the Articles of Incorporation may be amended by a two-thirds vote of those present at any regular meeting of the Trustees, provided that the same shall be ratified by a vote of two-thirds of the members present at any regular meeting of the Academy or at a special meeting called for such purpose, notice of such special meeting to be published in some newspaper in the city of Davenport at least one week prior to the time of holding same.

BY-LAWS
OF THE
DAVENPORT ACADEMY OF SCIENCES.

Amended February 5, 1907.

Article I.—MEMBERS.

Section 1.—Regular members shall be elected as follows: The name of any person who is recommended in writing by two regular members shall be posted in the Academy building for at least one week and then voted upon by the Executive Committee, a two-thirds vote being necessary for election.

The annual dues of the Regular Members shall be three (\$3.00) dollars payable on the first day of January, in advance, except that for members elected after March a deduction of seventy-five (75) cents shall be made for each fully completed quarter.

Any Regular Member may become a Life Member by paying fifty (\$50) dollars to the Treasurer and notifying the Secretary, thereby becoming exempt from further dues.

Section 2.—Any person not residing in Davenport may become a Corresponding Member of the Academy in the same manner as that prescribed for Regular Members. Corresponding Members shall have the privileges of Regular Membership except those of voting and holding office, but shall be exempt from dues. Any Corresponding Member may become a Regular Member by notifying the Secretary and paying his dues.

Section 3.—Any person eminent for his attainments in science may be elected an Honorary Member at the annual meeting only of the Academy upon nomination by the Board of Trustees, and shall have the privileges of Regular Membership except those of voting and holding office, but shall be exempt from dues. The number of Honorary members shall not exceed twenty-five.

Article II.—DUTIES OF OFFICERS.

Section 1. The President, or in his absence or inability to serve, the Vice-President, shall preside over the meetings of the Academy and of the Board of Trustees, and shall perform such duties as usually appertain to his office.

Section 2.—The Secretary shall keep a record of meetings, shall notify members and officers of election, and shall perform such duties as ordinarily appertain to his office both for the Academy and for the Board of Trustees.

Section 3.—The Treasurer shall receive and disburse all moneys of the Academy under the direction of the Board of Trustees, shall make a written annual report, shall give such bonds as the Board of Trustees shall require, and in general shall perform such duties as ordinarily appertain to his office.

Section 4.—The Board of Trustees shall transact the business of the Academy, shall have control of all expenditures of money, shall engage such officials as are hereinafter provided for or as may be needed for the welfare of the Academy, shall make rules for the Museum and Library, and shall have full power to act for the interests of the Academy in any way not inconsistent with the Constitution and By-Laws.

Section 5.—Any vacancy caused by the death or resignation of any officer or trustee shall be filled by the Board of Trustees, but a Trustee so elected shall hold office only until a successor is chosen at the next annual meeting of the Academy.

Article III.—STAFF.

Section 1.—The Board of Trustees shall appoint a Director, a Curator, a Librarian, an Editor, and such other officials and assistants as may be needed for the welfare of the Academy, and shall fix the term and compensation for all such appointments.

Section 2.—The Director, subject to the Board of Trustees, shall be entrusted with the general executive direction of the scientific and other activities of the Academy.

Section 3.—The Curator shall have general charge of the Museum.

Section 4.—The Librarian shall have general charge of the Library.

Section 5.—The Editor shall have general charge of the publications of the Academy.

Article IV.—COMMITTEES.

Section 1.—The Standing Committees shall consist of an Executive Committee, Finance Committee, Advisory Committee, Museum Committee, Library Committee, Historical Committee, Art Committee, Publication Committee, and Lecture Committee.

The President shall appoint all the Standing Committees, except as hereinafter provided, at the annual meeting or as soon thereafter as practicable.

Section 2.—The Executive Committee shall consist of five members, the President, the Vice-President, the Secretary, and the Treasurer, *ex-officio*, and one Trustee to be appointed by the President. The Committee, under the direction of the Board of Trustees, shall act in all matters of routine and shall elect the members of the Academy as hereinbefore provided.

Section 3.—The Finance Committee shall consist of three members and consider all matter concerning the financial interests of the Academy. The Treasurer shall be an *ex-officio* member of this committee.

Section 4.—The Advisory Committee shall consist of the President, the Director, the Curator, the Librarian, the Editor, and of the Chairman of the Museum, Library, Historical, Art, Publication and Lecture Committees.

It shall be the business of this Committee to consider such matters dealing with the scientific and other activities of the Academy as are referred to it by the Board of Trustees, and to present to the Trustees recommendations for the welfare of the Academy.

Section 5.—The Museum Committee shall consist of three members and shall consider all matters that have to do with the welfare of the Museum. The Director and Curator shall be consulting members of this committee, *ex-officio*.

Section 6.—The Library Committee shall consist of three members and shall consider all matters that have to do with the welfare of the Library. The Director and Librarian shall be consulting members of this committee, *ex-officio*.

Section 7.—The Historical Committee shall consist of three members and shall consider all questions that have to do with historical matters. The Director shall be a consulting member of this committee, *ex-officio*.

Section 8.—The Art Committee shall consist of three members and shall consider all matters that have to do with the welfare of the Gallery. The Director shall be a member of this committee, *ex-officio*.

Section 9.—The Publication Committee shall consist of five members and shall direct the publications of the Academy. The Director and the Editor shall be members of the Publication Committee, *ex-officio*.

Section 10.—The Lecture Committee shall arrange for lectures and public meetings of the Academy. The Director shall be an *ex-officio* member of this committee.

Article V.—MEETINGS.

Section 1.—The regular annual meeting of the Academy shall be held on the second Tuesday in January, at which time the order of business shall be as follows:

1. Reading of minutes of last annual meeting.
2. Annual reports of officers and committees.
3. The President's address.
4. Election of officers.
5. Other business.
6. Adjournment.

Section 2.—Regular meetings of the Academy for the reading of papers and discussion shall be held on the last Friday of each month.

Section 3.—Regular meetings of the Board of Trustees shall be held on the second Friday of each month at which the order of business shall be:

1. Reading of minutes.
2. Reports of officers and committees.
3. Deferred business.
4. New business.
5. Adjournment.

Section 4. Special meetings of the Academy may be called at any time by the President or the Board of Trustees, or upon written request of five members. Special meetings of the Board of Trustees may be called at any time by the President, or upon the written request of three Trustees.

Section 5.—Ten members shall constitute a quorum at any meeting of the Academy, and four Trustees at any meeting of the Board of Trustees.

Section 6.—Where not in conflict with the Constitution and By-Laws, the Academy shall be governed by Robert's Rules of Order.

Article VI.—SECTIONS.

Section 1.—Sections of the Academy holding separate meetings may be formed upon the written application of five members, by consent of the Trustees.

Section 2.—Membership in the Sections shall be open only to members of the Academy.

Section 3.—All collections, books, and permanent funds of the Sections shall be the property of the Trustees of the Academy.

Section 4.—Sections shall make an annual report to the Academy.

Section 5.—Sections shall have the right to make additional regulations for perfecting the organization, subject to the approval of the Trustees.

Article VII.—PUBLICATIONS.

Section 1.—Under the direction of the Editor, subject to the approval of the Publication Committee, the Academy shall publish a series to be known as the "Proceedings of the Davenport Academy of Sciences" and such other publications as may seem to promote the objects of the Academy.

Section 2.—The Academy shall exchange its publications with those of other societies, universities, libraries, and journals.

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CORRECTIONS.

Page	4. 3d line from bottom, add (Plate 13).	
37.	For <i>Acer nigra</i>	read <i>Acer nigrum</i> .
37.	<i>Acer saccharinum</i>	<i>Acer saccharinum</i> .
41.	<i>Ulnus fulva</i>	<i>Ulmus fulva</i> .
63.	<i>Hordeum jubatum</i>	<i>Hordeum jubatum</i> .
63.	<i>Scirpus palustris</i>	<i>Scirpus palustris</i> .
63.	<i>Polygonum mühlenbergii</i>	<i>Polygonum mühlenbergii</i> .
63.	<i>Rumex maritimus</i>	<i>Rumex maritimus</i> .
63.	<i>Distichlis apicata</i>	<i>Distichlis spicata</i> .
64.	<i>Habenaria psychodes</i>	<i>Habenaria psychodes</i> .
65.	<i>Dodecatheon media</i>	<i>Dodecatheon meadia</i> .
65.	<i>Maianthemum canadense</i>	<i>Maianthemum canadense</i> .
65.	<i>Viola blanda</i>	<i>Viola blanda</i> .
65.	<i>Cypripedium pubescens</i>	<i>Cypripedium pubescens</i> .
68.	<i>B. venenosus liquefaciens</i>	<i>B. venenosus liquefaciens</i> .
69.	<i>Quercus rubra</i>	<i>Quercus rubra</i> .
69.	<i>Triostetum perfoliatum</i>	<i>Triosteum perfoliatum</i> .
70.	<i>Arabis lyrata</i>	<i>Arabis lyrata</i> .
70.	<i>Acer rubra</i>	<i>Acer rubrum</i> .
70.	<i>Pyrus iowensis</i>	<i>Pyrus ioensis</i> .
70.	<i>Dodecatheon media</i>	<i>Dodecatheon meadia</i> .
71.	<i>Diervillia trifida</i>	<i>Diervilla trifida</i> .
71.	<i>Coptis trifolia</i>	<i>Coptis trifolia</i> .
71.	<i>Pyrus iowensis</i>	<i>Pyrus ioensis</i> .
71.	<i>Quercus macrocarpa</i>	<i>Quercus macrocarpa</i> .
72.	<i>Poa pratense</i>	<i>Poa pratensis</i> .
72.	<i>Populus monilifera</i>	<i>Populus monilifera</i> .
72.	<i>Dulichium spatheum</i>	<i>Dulichium spathaceum</i> .
72.	<i>Poa scratina</i>	<i>Poa serotina</i> .
72.	<i>Pinus stroba</i>	<i>Pinus strobus</i> .
72.	<i>Taxus canadensis</i>	<i>Taxus canadensis</i> .
73.	<i>Phegopteris</i>	<i>Phegopteris</i> .
73.	<i>Phegopteris polypodioides</i>	<i>Phegopteris polypodioides</i> .
74.	<i>Dodecatheon media</i>	<i>Dodecatheon meadia</i> .
78.	<i>Lysimachia thyriflora</i>	<i>Lysimachia thyriflora</i> .
78.	<i>Menyanthes trifolia</i>	<i>Menyanthes trifoliata</i> .
79.	<i>Eriophorum virginicum</i>	<i>Eriophorum virginicum</i> .
79.	<i>Cnicus muticus</i>	<i>Cnicus muticus</i> .
79.	<i>Parnassia caroliniana</i>	<i>Parnassia caroliniana</i> .
81.	<i>Glyceria arundinacea</i>	<i>Glyceria arundinacea</i> .
82.	<i>Viola carina</i>	<i>Viola canina</i> .
83.	<i>Ilysanthus riparia</i>	<i>Ilysanthus riparia</i> .
83.	<i>Nymphaea tuberosa</i>	<i>Nymphaea tuberosa</i> .
84.	<i>Phragmites communis</i>	<i>Phragmites communis</i> .
84.	<i>Burnus kalmii</i>	<i>Bromus kalmii</i> .
85.	<i>Elocharis</i>	<i>Eleocharis</i> .
87.	<i>Menyanthes trifolia</i>	<i>Menyanthes trifoliata</i> .
88.	<i>Populus tremuloides</i>	<i>Populus tremuloides</i> .
89.	<i>Castilleja sessilifolia</i>	<i>Castilleja sessiliflora</i> .
91.	<i>Poa nemoralis</i>	<i>Poa nemoralis</i> .
93.	<i>Lithospermum angustifolius</i>	<i>Lithospermum angustifolium</i> .
93.	<i>Castilleja sessilifolia</i>	<i>Castilleja sessiliflora</i> .
96.	<i>Pyrus iowensis</i>	<i>Pyrus ioensis</i> .
98.	<i>Diervilla trifida</i>	<i>Diervilla trifida</i> .
99.	<i>Helianthemum canadense</i>	<i>Helianthemum canadense</i> .
100.	<i>Pruus virginiana</i>	<i>Prunus virginiana</i> .
101.	<i>Fraxinus viridis</i>	<i>Fraxinus viridis</i> .
101.	<i>Pyrus iowensis</i>	<i>Pyrus ioensis</i> .
102.	<i>Cnicus mutians</i>	<i>Cnicus muticus</i> .
104.	<i>Menyanthes trifoliata</i>	<i>Menyanthes trifoliata</i> .
105.	<i>Camptosorus rhexophyllus</i>	<i>Camptosorus rhizophyllus</i> .
110.	<i>Scirpus lacustris</i>	<i>Scirpus lacustris</i> .
110.	<i>Populus monilifera</i>	<i>Populus monilifera</i> .
111.	<i>Asarum canadense</i>	<i>Asarum canadense</i> .
112.	<i>Calamagrostis canadensis</i>	<i>Calamagrostis canadensis</i> .
112.	<i>Dodecatheon media</i>	<i>Dodecatheon meadia</i> .
113.	<i>Dodecatheon media</i>	<i>Dodecatheon meadia</i> .
116.	<i>Arenaria latifolia</i>	<i>Arenaria laterifolia</i> .
116.	<i>Spirea aruncus</i>	<i>Spirea aruncus</i> .
116.	<i>Panicum autumnale</i>	<i>Panicum autumnale</i> .

Following page 162. The unnumbered plate is Plate X.

Page 205, line 16 from bottom. For 1907, read 1906.

Explanation of Plate IX, figure 2, Fossil Plant Remains. For toredo, read teredo.

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